HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

3335A

SYNTHESIZER/LEVEL GENERATOR

Serial Numbers: 1640A00286 and Greater

IMPORTANT NOTICE

This loose leaf manual does not normally require a change sheet. All major change information has been integrated into the manual by page revision. In cases where only minor changes are required, a change sheet may be supplied.

If the Serial Number of your instrument is lower than the one on this title page, the manual contains revisions that do not apply to your instrument. Backdating information given in the manual adapts it to earlier instruments.

Where practical, backdating information is integrated into the text, parts list and schematic diagrams. Backdating changes are denoted by a delta sign. An open delta (Δ) or lettered delta (Δ_A) on a given page, refers to the corresponding backdating note on that page. Backdating changes not integrated into the manual are denoted by a numbered delta (Δ_1) which refers to the corresponding change in the Backdating section (Section VII).

WARNING

To prevent potential fire or shock hazard, do not expose equipment to rain or moisture.

Manual Part Number 03335-90003

Microfiche Part Number 03335-90051

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P.O. Box 301, Loveland, Colorado 80537 U.S.A.

Printed: August 1978

HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment [,except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period] . During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

Hewlett-Packard warrants that its software and firmware designated by -hp- for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This Operating and Service Manual contains information relative to the installation, operation, performance testing, adjustment and maintenance of the Hewlett-Packard Model 3335A Synthesizer/Level Generator. Figure 1-1 shows the Synthesizer/Level Generator and the accessories supplied with the instrument.

1-3. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should be kept with the instrument for use by the operator. Additional copies of the Operating Information Supplement or the Operating and Service Manual can be ordered through your nearest Hewlett-Packard Sales and Service Office (a list of these offices is provided at the end of this manual). The part numbers are listed on the title page of this manual.

1-4. Also listed on the title page of this manual following the Operating and Service Manual and Operating Information Supplement part numbers are Microfiche part numbers for these publications. These numbers can be used to order 4 x 6 inch microfilm transparencies of these publications. The Microfiche package includes the latest Manual Changes supplement and all pertinent Service Notes.

1-5. The manual is divided into eight sections, each covering a particular topic for the operating and service of the Synthesizer/Level Generator. The topics by section number are:

Section	Topic
I	General Information
II	Installation
III	Operation
IV	Performance Tests
V	Adjustments
VI	Replacement Parts
VII	Manual Changes
VIII	Service

1-6. This section contains general information about the Model 3335A Synthesizer/Level Generator. The information includes an instrument description, specifications, option and accessory information and instrument and manual identification.

1-7. DESCRIPTION.

1-8. The Model 3335A Synthesizer/Level Generator is a wide range source operating over the range of 200 Hz to 80 MHz with output resolution of .001 Hz. The Synthesizer/Level Generator is capable of making a step frequency sweep both automatically or manually under operator control from the keyboard. Output amplitude is selectable over the range of + 13.01 dBm to - 86.98 dBm for the 50 ohm output and + 11.25 dBm to - 88.74 dBm for the 75 ohm output.

1-9. The 3335A Synthesizer/Level Generator provides three communications-oriented options in addition to the standard 50 ohm and 75 ohm output impedance. Options 002 and 004 provide output impedance of 75 ohms unbalanced, 124 ohms balanced and 135 ohms balanced each terminated in equivalent WECO output connectors (Option 004 contains miniature connectors). Option 003 provides a 75 ohm unbalanced BNC output and a 150 ohm balanced BNC pair output. Refer to Table 1-2, General Information, for the amplitude range of the Options.

1-10. The Synthesizer/Level Generator develops the output signal by an indirect synthesis technique. This technique uses voltage controlled oscillators which are phase-locked to reference signals generated by a 40 MHz master oscillator in the reference section. The master oscillator is phase-locked to an internal temperature-stabilized oscillator or can be phase-locked to an external reference signal. A 10 MHz signal derived from the master oscillator is available at a rear panel connector for use as a reference signal for other equipment.

1-11. Frequency and amplitude can be selected manually from the keyboard or externally when connected to the Hewlett-Packard Interface Bus (HP-IB). A programmable device such as a programmable calculator is capable of remotely controlling the Synthesizer/Level Generator from the HP-IB. When operated in this mode, keyboard inputs are disabled.

1-12. SPECIFICATIONS.

1-13. Table 1-1 is a complete list of the Model 3335A critical specifications that are controlled by tolerances. Any changes in specifications due to manufacturing, design or traceability to the U.S. National Bureau of Standards are included in Table 1-1 of this manual. Specifications listed in this manual supersede all previous specifications for the Model 3335A.

1-14. GENERAL OPERATING INFORMATION.

1-15. Table 1-2 contains general information describing the major operating characteristics of the 3335A. This information does not constitute specifications but is supplemental operating information.

Figure 1-1. -hp- 3335A With Supplied Accessories.

1-16. OPTIONS.

1-17. There are both equipment options and accessory options available with the 3335A Synthesizer/Level Generator. All options are designated by a three digit number. The first digit of the option number identifies the option as either equipment or accessory. For an equipment option, the first digit is a zero and for an accessory option, the first digit is a nine. The following is a list of equipment and accessory options available with the 3335A:

Option	Description
001	High stability crystal oven (10544A)
002	75 Ω Unbalanced Output Connector: Commercial equivalent of WECO type 477B (Accepts WECO plug 358A). 124 Ω Balanced Output Connectors: Commercial equivalent of WECO type 477B (Accepts WECO plug 372A). 135 Ω Balanced Output Connectors: Commercial equivalent of WECO type 223A (Accepts WECO plug 241A).
003	75 Ω Unbalanced Output Connector: BNC 150 Ω Balanced Output Connectors: BNC pair.
004	75 Ω Unbalanced Output Connector: Commercial equivalent of WECO type 560A (Accepts WECO plug 439A or 440A). 124 Ω Balanced Output Connectors: Commercial equivalent of WECO type 562A (Accepts WECO plug 443A). 135 Ω Balanced Output Connectors: Commercial equivalent of WECO type 223A (Accepts WECO plug 241A).
907	Front Handle Assembly
908	Rack Mount Flange Kit
909	Rack Mount Flange Kit/Front Handle Assembly
910	Additional Operating and Service Manual

1-18. For more information concerning these options, refer to Table 1-2, General Information, or contact your local -hp- Sales and Service Office. A list of the -hp- Sales and Service Offices is provided at the end of this manual.

1-19. ACCESSORIES SUPPLIED.

1-20. The following is a list of accessories supplied with the Model 3335A. This list comprises the 3335A service kit, -hp- Part No. 03335-87901.

Accessory	Qty.	-hp- Part No.
Extender Board	2	5061-0775
Extender Board	2	03335-66518
Service Cable	1	03335-61602
Service Cable	1	03335-61627
SMA–to–BNC Adapter	1	1250-1548
BNC-to-BNC Adapter	1	1250-1499

1-21. ACCESSORIES AVAILABLE.

1-22. The following is a list of Hewlett-Packard accessories available for use with the Model 3335A:

Accessory	-hp- Model No.
50 Ω Feedthrough	11048C
75 Ω Feedthrough	11094C

1-23. HP-IB INTERFACING AND PROGRAMMING INFORMATION.

1-24. Section II of this manual contains instructions for interfacing the Model 3335A with the HP-IB. A brief description of the sequence of events comprising the transfer of data by the HP-IB is provided in Section III followed by programming information. Information concerning the design criteria of the bus is available in IEEE Standard 488-1975, titled "IEEE Standard Digital Interface for Programmable Instrumentation".

1-25. INSTRUMENT AND MANUAL IDENTIFICATION.

1-26. The instrument serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix. A letter between the prefix and suffix identifies the country in which the instument was manufactured (A = USA, G = West Germany, J = Japan, U = United Kingdom). All correspondence with Hewlett-Packard concerning this instrument should include the complete serial number.

1-27. If the serial number of your instrument is lower than the serial number on the title page of this manual, you must modify your manual for agreement with your instrument. Refer to Section VII, MANUAL CHANGES, for the information that will adapt this manual to your instrument.

1-28. SAFETY CONSIDERATIONS.

1-29. The Synthesizer/Level Generator is a Safety Class I instrument and has been designed according to international safety standards. To ensure safe operation and to retain the instrument in a safe condition, this Operating Manual contains information, cautions and warnings which must be adhered to by the user.

1-30. The 3335A's front panel contains a ⚠ symbol which is an international symbol meaning "refer to the

Operating Manual." The symbol flags important operating instructions located in Section III required to prevent damage to the instrument. To retain the operating condition of the instrument, these instructions must be adhered to.

1-31. RECOMMENDED TEST EQUIPMENT.

1-32. Equipment required to maintain the Model 3335A is listed in Table 1-3. Other equipment can be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-1. Specifications.

STANDARD/OPTION 001

FREQUENCY:

Range: 50 Ω / 75 Ω: 200 Hz to 80.999 999 999 MHz

Stability (Standard):

Long Term: ± 1×10^{-8} per day
± 1×10^{-7} per month

Stability (Option 001):

Long Term: < 5×10^{-10}/day after 24-hour warmup and oscillator off time less than 24 hours. < 1×10^{-7}/year for continuous operation

Spectral Purity:

Harmonic Distortion:

All harmonically related signals will be less than the following levels (relative to the fundamental) at full output:

Freq Range	Harmonic Level
200 Hz to 10 MHz	–45 dB
10 MHz to 80 MHz	–40 dB

Integrated Phase Noise:

(30 kHz band, excluding ± 1 Hz, centered on the carrier)

9.9 MHz:	< –63 dB
20 MHz:	< –70 dB
40 MHz:	< –64 dB
80 MHz:	< –58 dB

Spurious (25°C ± 10°C):

All non-harmonically related signals are > 75 dB below the carrier or –125 dBm whichever is greater.

AMPLITUDE:

Range: 50 Ω: +13.01 dBm to –86.98 dBm
75 Ω: +11.25 dBm to –88.74 dBm

Absolute Level Accuracy:

(Maximum output at 100 kHz, 10°C to 35°C) ± 0.05 dB

Flatness: (Relative to 100 kHz, Full Amplitude)

50 Ω/75 Ω: 1 kHz–25 MHz: ± .07 dB; 200 Hz–80 MHz: ± .15 dB

Attenuator Accuracy: (Relative to Full Output, 100 kHz, In 2 dB Steps)

Impedance*	Attenuation (dB)	Accuracy 200 Hz	Accuracy 25 MHz	Accuracy 80 MHz
50 Ω	0 to 18	± 0.04 dB		
75 Ω				± 0.15 dB
50 Ω	20 to 58	± 0.09 dB		
75 Ω				± 0.25 dB
50 Ω	60 to 98	± 0.20 dB		
75 Ω				± 0.50 dB

Table 1-1. Specifications (Cont'd).

OPTION 002/004

FREQUENCY:

Range: 75 Ω: 200 Hz to 80.999 999 999 MHz
124 Ω: 10 kHz to 10 MHz
135 Ω: 10 kHz to 2 MHz

Stability:
Long Term: ± 1 x 10^{-8} per day
± 1 x 10^{-7} per month
See STANDARD/OPTION 001 table for Option 001 stability.

Spectral Purity:
Harmonic Distortion:
All harmonically related signals will be less than the following levels (relative to the fundamental) at full output:
(75 Ω) 0 dBm (124 Ω, 135 Ω)

Impedance	Freq Range	Harmonic Level
75 Ω	200 Hz to 10 MHz	–45 dB
	10 MHz to 80 MHz	–40 dB
124 Ω	10 kHz to 10 MHz	–45 dB
135 Ω	10 kHz to 2 MHz	–45 dB

Integrated Phase Noise:
(30 kHz band, excluding ± 1 Hz, centered on the carrier)
9.9 MHz: < –63 dB
20 MHz: < –70 dB
40 MHz: < –64 dB
80 MHz: < –58 dB

Spurious (25°C ± 10°C):

Impedance	All non-harmonically related signals (whichever is greater)
75 Ω	–125 dBm or –75 dBc
124 Ω	–97 dBm or –75 dBc (dc to 200 MHz)
135 Ω	–100 dBm or –75 dBc (dc to 10 MHz) –68 dBm or –75 dBc (10 MHz–200 MHz)

AMPLITUDE:

Range: 75 Ω, 124 Ω, 135 Ω: +11.25 dBm to –88.74 dBm

Absolute Level Accuracy: (Maximum output at 100 kHz, 10°C to 35°C)
75 Ω: ± 0.05 dB
124/135 Ω: ± 0.1 dB

Flatness: (Relative to 100 kHz, Full Amplitude)

75 Ω	1 kHz–25 MHz: ± .07 dB
	200 Hz–80 MHz: ± .15 dB
124 Ω	50 kHz–10 MHz: ± .15 dB
	10 kHz–10 MHz: ± .4 dB
135 Ω	10 kHz–2 MHz: ± .18 dB

Amplitude Accuracy (includes effects of flatness and attenuator):

75 Ω:

75 Ω Output Level (dBm)	200 Hz	1 kHz	25 MHz	50 MHz
+11.25	± 0.25 dB	± 0.15 dB	± 0.35 dB	
– 8.74	± 0.30 dB	± 0.20 dB	± 0.45 dB	
–48.74	± 0.40 dB	± 0.30 dB	± 0.70 dB	
–70.0*				

124 Ω:

124 Ω Output Level (dBm)	10 kHz	50 kHz	10 MHz
+11.25	±0.60 dB	± 0.35 dB	
– 8.74	± 0.65 dB	± 0.40 dB	
–48.74	± 1.1 dB	± 0.85 dB	
–70.0*			

135 Ω

135 Ω Output Level (dBm)	10 kHz	2 MHz
+11.25	± 0.35 dB	
– 8.74	± 0.40 dB	
–48.74	± 0.85 dB	
–70.0*		

Output Balance: 124/135 Ω: ≥60 dB

*Levels to –88.74 dBm can be selected but accuracies are unspecified due to the spurious noise floor of –100 dBm.

Table 1-1. Specifications (Cont'd).

OPTION 003

FREQUENCY:

Range: 75 Ω: 200 Hz to 80.999 999 999 MHz
150 Ω: 10 kHz to 2 MHz

Stability:
Long Term: $\pm 1 \times 10^{-8}$ per day
$\pm 1 \times 10^{-7}$ per month
See STANDARD/OPTION 001 table for Option 001 stability.

Spectral Purity:
Harmonic Distortion:
All harmonically related signals will be less than the following levels (relative to the fundamental) at full output:

Freq Range	Harmonic Level
200 Hz to 10 MHz	–45 dB
10 MHz to 80 MHz	–40 dB

Integrated Phase Noise:
(30 kHz Band, excluding ± 1 Hz, centered on the carrier)

9.9 MHz < –63 dB
20 MHz < –70 dB
40 MHz < –64 dB
80 MHz < –58 dB

Spurious (25°C ± 10°C)

Impedance	All non-harmonically related signals (whichever is greater)
75 Ω	–125 dBm or –75 dBc
150 Ω	–100 dBm or –75 dBc

AMPLITUDE:

Range: 75 Ω, 150 Ω: +11.25 dBm to –88.74 dBm

Absolute Level Accuracy (Maximum Output at 100 kHz, 10°C to 35°C)
75 Ω: ± 0.05 dB
150 Ω: ± 0.10 dB

Flatness (relative to 100 kHz, Full Amplitude):
75 Ω: 1 kHz–25 MHz: ± 0.07 dB
200 Hz–80 MHz: ± 0.15 dB
150 Ω: 10 kHz–2 MHz: ± 0.18 dB

Amplitude Accuracy (includes the effects of flatness and attenuator):

75 Ω:

75 Ω Output Level (dBm)

	200 Hz	1 kHz	25 MHz	80 MHz
+11.25	± 0.25 dB	± 0.15 dB	± 0.35 dB	
– 8.74	± 0.30 dB	± 0.20 dB	± 0.45 dB	
–48.74	± 0.40 dB	± 0.30 dB	± 0.70 dB	
–88.74				

150 Ω:

150 Ω Output Level (dBm)

	10 kHz	2 MHz
+11.25	± 0.35 dB	
– 8.74	± 0.40 dB	
–48.74	± 0.85 dB	
–70.0*		

*Levels to –88.74 dBm can be selected but accuracies are unspecified due to the spurious noise floor of –100 dBm.

Table 1-2. General Information.

Output Impedance: (Selected by a front panel switch)
Standard: 50 ohms or 75 ohms
Option 002/004: 75 ohms unbalanced, 124 ohms balanced and 135 ohms balanced
Option 003: 75 ohms unbalanced and 150 ohms balanced

Frequency Range:
Standard:
50 Ω: 200 Hz to 80 099 999.999 Hz
75 Ω: 200 Hz to 80 099 999.999 Hz
Option 002/004:
75 Ω: 200 Hz to 80 099 999.999 Hz
124 Ω: 10 kHz to 10 MHz
135 Ω: 10 kHz to 2 MHz
Option 003
75 Ω: 200 Hz to 80 099 999.999 Hz
150 Ω: 10 kHz to 2 MHz

Frequency Resolution: 0.001 Hz

Frequency Display: 11 digits

Frequency Settling Time: < 20 msec to within 90° of final phase.

Frequency Sweep Mode:
Auto: ≈8 sweeps/sec, 100 steps/sweep
Manual, single 10 sec and 50 sec sweep: 1000 steps/sweep

Amplitude Range:
Standard:
50 ohms: +13.01 dBm to –86.98 dBm
75 ohms: +11.25 dBm to –88.74 dBm
Option 002:
75 ohms unbalanced:
124 ohms balanced: } +11.25 dBm to –88.74 dBm
135 ohms balanced: }
Option 003:
75 ohms unbalanced: +11.25 dBm to –88.74 dBm
150 ohms balanced:
Option 004: Same as Option 002

Amplitude Settling Time: < 500 msec to within 0.02 dB of final value.

Internal Frequency Reference:
Frequency stability is obtained by use of a 10 MHz crystal oscillator in a temperature-stabilized oven. A high-stability 10 MHz temperature-stabilized crystal oscillator is provided by Option 001. The master 40 MHz oscillator of the instrument reference section is capable of operating open loop (no oven or external reference) but the frequency stability is not specified.

External Frequency Reference:
The 40 MHz master oscillator of the reference section can be phase-locked to an external reference through a rear panel BNC connector. The amplitude and frequency requirements of the external signal are - 7 dBm to + 7 dBm (+ 0.1 V to + 0.5 V) with frequency being a sub-harmonic of 40 MHz and ⩾1 MHz.

Remote Programming:
The 3335A is a fully programmable instrument designed for systems interfacing with the Hewlett-Packard Interface Bus (HP-IB). It will recognize a preset listen address and accept bit-parallel, word (byte) serial ASCII coded instructions. The address is preset by five rear panel listen address switches. A brief description of the HP-IB with address and programming information is provided in Section III.

Programmability:
All FUNCTION keys except DISPLAY, all DATA keys including the ENTRY keys, all INCR keys and all FREQUENCY keys except the MANUAL TUNE keys and MANUAL SWEEP key are programmable. The POWER key and the impedance selection switch are not programmable.

HP-IB Connector:
The rear panel HP-IB connector provides all lines for remote control and digital output using the HP-IB. The connector is compatible with the -hp- 10631 (A, B or C) HP-IB cables and contains metric threaded cable mounting studs.

Maximum HP-IB Cable Length:
2 meters (6.56 feet) per device; 20 meters (65.6 feet) total accumulation per system.

HP-IB Lines:
The 3335A uses all of the HP-IB lines except EOI (End or Identify), SRQ (Service Request) and the data line DIO 8.

Data Input/Output:
All data is received through the HP-IB Data Input/Output (DIO) lines.

Data Transfer Timing:
Timing of data transfer is controlled by "handshake" lines DAV, NRFD and NDAC.

HP-IB Logic Levels:
TTL compatible low true (true state = digital ground or 0 V to 0.4 V dc; false state = open or + 2.5 V dc to + 5 V dc).

Isolation:
The HP-IB lines and 3335A are optical coupled.

Listen Address Code:
The 3335A is shipped from the factory with an ASCII listen address of $ (octal 044). Instructions for changing the listen address are provided in Section III.

HP-IB Bus Commands:
The 3335A will respond to certain Unaddress, Universal and Addressed Commands (see information on Remote Programming in Section III).

Telecommunications Features:
Amplitude blanking of the output signal at each change of output frequency is obtainable except in the manual tune and manual sweep modes. Special sweep feature allows each frequency step to be held for four seconds and also includes amplitude blanking.

General
Operating Temperature: 0°C to 55°C
Storage Temperature: - 40°C to + 75°C
Power Requirements: 100 V, 120 V, 220 V or 240 V ac, + 5% - 10%, 48 Hz to 66 Hz, 200 VA Maximum

Dimensions:
Dimensions in millimeters and (inches):
Height: 133.4 (5 1/4)
Width: 425.5 (16 3/4)
Depth: 501.7 (19 3/4)

Weight:
Weight in kilograms and (pounds): 19.05 (42)

Table 1-3. Recommended Test Equipment.

Equipment	Required Characteristics	Perf. Tests	Adj.	T.S.	Recommended Model
3335A Service Kit Consists of:	(Supplied with the instrument)		X	X	-hp- 03335-87901
(2) Extender Boards				X	-hp- 5061-0775
(1) Extender Board			X	X	-hp- 03335-66518
(1) Extender Board			X	X	-hp- 03335-66520
(1) Service Cable			X	X	-hp- 03335-61602
(1) Service Cable			X	X	-hp- 03335-61627
(1) SMA-to-BNC			X	X	-hp- 1250-1548
Terminations:					
50 Ω Feedthru		X		X	-hp- 11048C
75 Ω Feedthru		X		X	-hp- 11094B
Adapters:					
BNC "TEE"		X			-hp- 1250-0781
Conn. Adapter		X			-hp- 1250-0591
(2) BNC Male-to-Male		X			-hp- 1250-0216
(2) Type N(f) to BNC (m)		X			-hp- 1250-0077
(2) Type N(m) to BNC (f)		X			-hp- 1250-0780
(2) BNC (f) to dual banana plug		X	X	X	-hp- 1251-2277
Thermal Converter	Impedance: 50 Ω or 75 Ω Frequency Range: 200 Hz – 10 MHz Frequency Response: ± 0.05 dB 200 Hz – 10 MHz Input Voltage: 1 V rms	X			-hp- 11050A (50 Ω) or -hp- 11050A/H01 (75 Ω)
Double Balanced Mixer	Impedance: 50 Ω Frequency Range: 50 kHz to 80 MHz	X			-hp- 10534A
Attenuator	Certified (See Note 1) Range: 0–12 dB Steps: 1 dB	X			-hp- 355C
Attenuator	Certified (See Note 1) Range: 0–120 dB Steps: 10 dB	X			-hp- 355D
Attenuator	Fixed: 3 dB Accuracy: ± 0.3 dB	X			-hp- 8491A Option 003
Attenuator	Fixed: 6 dB Accuracy: ± 0.3 dB	X			-hp- 8491A Option 006
Digital Voltmeter	AC Function: Full Scale Ranges: 1 V, 10 V Freq. Range: 200 Hz–100 kHz Accuracy: ± 0.5% Resolution: 0.1 mV Input Impedance: > 1 mΩ < 90 pF DC Function: Full Scale Ranges: 100 mV–20 V Accuracy: ± 0.15% Resolution: 5 digits Input Resistance: > 1 MΩ	X	X	X	-hp- 3455A
AC Voltmeter	Full Scale Ranges 0.1 – 1 V Frequency Range: 200 Hz to 4 MHz Accuracy: ± 10% Input Impedance: 10 MΩ, < 25 pF	X		X	-hp- 400FL
Oscilloscope	Vertical Sensitivity: 0.005 V/div to 2 V/div Sweep: 0.05 μs/div to 0.1 sec/div Input Impedance: 1 MΩ, < 20 pF Input Coupline: ac/dc	X	X	X	-hp- 180C/D, 1805A, 1825A
Tracking Generator	Freq. Range: 100 kHz to 110 MHz Amplitude Range: 0 to –10 dB		X		-hp- 8443A

Table 1-3. Recommended Test Equipment.

Equipment	Required Characteristics	Perf. Tests	Adj.	T.S.	Recommended Model
Spectrum Analyzer	Frequency Range: 1 kHz–1.25 GHz Amplitude Accuracy: ± .5 dB Response: ± 0.5 dB	X	X	X	-hp- 141T, 8552B, 8553B, 8554B
Spectrum Analyzer	Frequency Range: 5 Hz to 50 kHz Amplitude Accuracy:± 0.5 dB Response: ± 3% Battery operation	X		X	-hp- 3580A Option 001
Wave Analyzer	Frequency Range: 15 Hz–50 kHz Accuracy: ± 3 Hz Amplitude Range: – 150 dBm – +30 dBm Accuracy: ± 0.5 dB Recorder Output: 0–+5 V ± 2.5%	X			-hp- 3581A
Amplifier	Frequency Range: 0.1–80 MHz Gain: 20 dB ± 0.5 dB at 10 MHz Response: ± 0.5 dB Noise Figure: < 5 dB Harmonic Distortion: –32 dB for 0 dBm output Impedance: 50 Ω	X			QB–300 Q-Bit Corp. P.O. Box 2208 Melbourne, FL 32901
Quartz Frequency Standard	Output: 5 MHz, 1 V rms into 50 Ω Short Term Stability: 5 parts in 10^{12} for 1 sec averaging time		X		-hp- 105A/B
Universal Counter	Frequency: 200 Hz–80 MHz Sensitivity: 50 mV rms Impedance: 1 MΩ, < 50 pF	X		X	-hp- 5328A
Power Meter	Power Range: 13.5 dB Frequency Range: 100 kHz to 80 MHz Accuracy: ± 0.05%	X			-hp- 436A
Power Sensor	Power Range: 0.3 μW to 100 mW Impedance: 50 Ω or 75 Ω Freq. Range: 100 kHz–80 MHz	X			-hp- 8482A (50 Ω) or -hp- 8483A (75 Ω)
1 MHz LPF	Cut Off Freq: 1 MHz Stopband Attn: 50 dB by 4 MHz Stopband Freq: 4 MHz–80 MHz	X			J903 TT Electronics,Inc. 2214 S. Barry Ave. Los Angeles, CA 90064
Synthesizer	Frequency Range: 10 MHz–80 MHz Amplitude Range: –10 dBm to +10 dBm Accuracy: ± 0.05 dB Phase Noise (30 kHz Integrated): 9.9 MHz: < –63 dB 20 MHz: < –70 dB 40 MHz: < –64 dB 80 MHz: < –58 dB	X			-hp- 3335A
Power Supply (2) Cables (2) Cables (2) Cables	Output: + 15 V	X X X X			-hp- 6215A -hp- 11170A -hp- 11170B -hp- 11170C
Active Probe	Input Impedance = 100 kΩ shunted by 3 pfds		X		-hp- 1120A

NOTE 1

Attenuators of known accuracy are required. Certification is obtainable from Hewlett-Packard. Contact your nearest Hewlett-Packard Sales and Service Office. A list of offices is provided at the back of this manual.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for installing and interfacing the Model 3335A Synthesizer/Level Generator. Included are initial inspection procedures, power and grounding requirements, line voltage selection, environmental requirements, installation instructions, HP-IB connection procedure and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard Sales and Service Office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The warranty statement is located at the front of this manual.

2-5. PREPARATION FOR USE.

2-5(a). Reference Frequency.

2-5(b). A stable frequency reference must be connected to the 40/N MHz REFerence INPUT located on the rear panel. If the internal 10 MHz reference is to be used, the BNC-to-BNC Adapter (see Figure 6-2 Item 25) must be connected from the 10 MHz REFerence OVEN output, also located on the rear panel, to the 40/N M/Hz REFerence INPUT. The BNC-to-BNC Adapter is packed with the accessories.

2-6. Power Requirements.

2-7. The Model 3335A Synthesizer/Level Generator requires a power source of 100, 120, 220 or 240 V ac, + 5%, - 10%, 48 to 66 Hz single phase. Power consumption is 200 VA maximum.

2-8. Line Voltage Selection.

CAUTION

Before switching on this instrument, be sure it is set for the line voltage of the power source. Also ensure the line power cord is connected to a protective earth contact.

2-9. Line voltage and fuse selection instructions are provided on the rear panel above the ac line connector. The line voltage is selected by the position of the two rear panel line voltage selection switches.

NOTE

The correct fuse rating for the line voltage selected is located on the rear panel between the fuse location and line voltage selection switch.

The line voltage and fuse are factory installed for 120 V operation.

WARNING

To maintain operator safety, the following precautions must be followed before the instrument power cable is connected:

a. Before the power cable is connected to a power source, the protective earth terminal of the instrument must be connected to earth ground. This is accomplished by ensuring that the instrument's ac line input connector earth terminal is correctly connected to the instrument's chassis and that the power cord ground conductor has continuity from end to end.

b. Note that the protection provided by grounding the instrument cabinet will be lost if a power cable not containing a ground conductor like the type supplied is used to connect the ac line voltage to the instrument.

c. The power cable plug must be inserted into a socket outlet provided with a protective earth contact. The protection of the grounded instrument cabinet must not be negated by the use of an extension cord without a protective ground conductor.

d. If this instrument is to be energized via an auto-transformer to reduce or increase the line voltage, make sure that the common terminal is connected to the earthed pole of the power source.

2-10. Power Cable.

2-11. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-1 for the part numbers of the power cable plugs available.

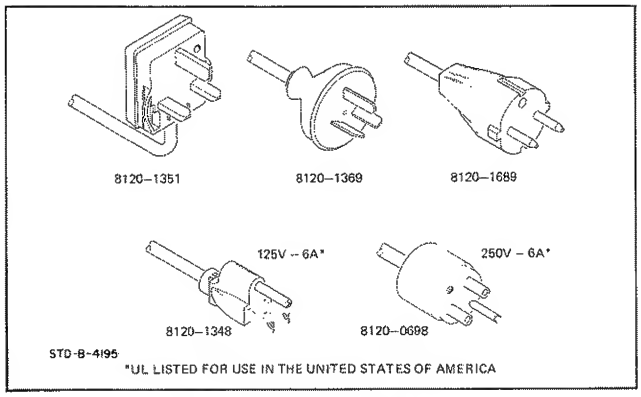


Figure 2-1. Power Cables.

2-12. HP-IB Connections.

2-13. Interconnection data concerning the rear panel HP-IB connector is provided in Figure 2-2. This connector is compatible with the -hp- 10631 (A, B, or C) HP-IB Cables. With the HP-IB system, you can interconnect up to fourteen (including the controller) HP-IB compatible instruments. The HP-IB Cables have identical "piggyback" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. You can interconnect system components and devices in virtually any configuration you desire. There must, of course, be a path from the calculator (or other controller) to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces great leverage which can damage the connector mounting. Be sure that each connector is firmly screwed in place to keep it from working loose during use (see CAUTION of Figure 2-2).

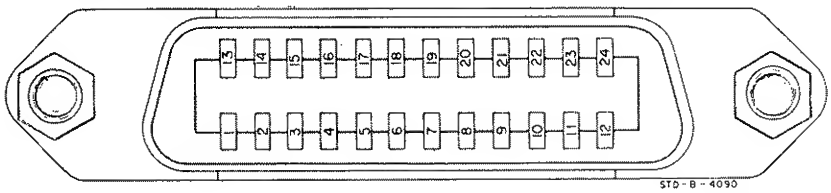
2-14. Cable Length Restrictions. To achieve design performance with the HP-IB, proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly and the system will fail to perform. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules:

a. The total cable length for the system must be less than or equal to 20 meters (65 feet).

b. The total cable length for the system must be less than or equal to 2 meters (6 feet) times the total number of devices connected to the bus.

2-15. 3335A Listen Address.

2-16. The 3335A contains a rear panel HP-IB Instrument listen address selection switch. There are five switches



PIN	LINE	
1	DI01	
2	DI02	
3	DI03	
4	DI04	
13	DI05	
14	DI06	
15	DI07	
16	DI08	
5	EOI	
17	REN	
6	DAV	
7	NRFD	
8	NDAC	
9	IFC	
10	SRQ	
11	ATN	
12	SHIELD–CHASSIS GROUND	
18	P/O TWISTED PAIR WITH PIN 6	THESE PINS ARE INTERNALLY GROUNDED
19	P/O TWISTED PAIR WITH PIN 7	
20	P/O TWISTED PAIR WITH PIN 8	
21	P/O TWISTED PAIR WITH PIN 9	
22	P/O TWISTED PAIR WITH PIN 10	
23	P/O TWISTED PAIR WITH PIN 11	
24	ISOLATED DIGITAL GROUND	

CAUTION

The 3335A contains metric threaded HP–IB cable mounting studs as opposed to English threads. Metric threaded -hp-10631A, B, or C HP–IB cable lockscrews must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrews is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable hardware illustrations and part numbers follow.

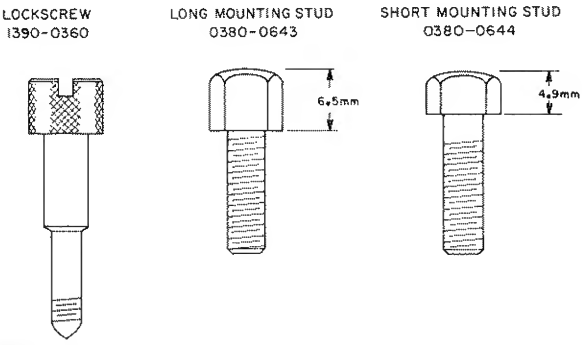


Figure 2-2. HP-IB Connector.

designated (5 . . . 1)which are used to select the listen address. Instructions for changing the listen address are provided in Section III of this manual along with 3335A programming codes.

2-17. HP-IB Descriptions.

2-18. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if you are not familiar with the HP-IB concept. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1975 titled "IEEE Standard Digital Interface for Programmable Instrumentation".

2-19. OPERATING ENVIRONMENT.

WARNING

To prevent potential electrical or fire hazard, do not expose equipment to rain or moisture.

2-20. Operating and Storage Temperature.

2-21. In order for the 3335A to meet the specifications listed in Table 1-1, the operating environment must be within the following limits:

Temperature. . . . . .0 to + 55°C
Humidity. . . . . .< 85% relative
Altitude. . . . . < 15,000 feet

2-22. Cooling System.

2-23. A forced air cooling system is used to maintain the operating temperature required by the instrument. The cooling fan is located on the right side of the instrument drawing air through the filtered side panel. When operating the instrument, choose a location that provides at least three inches of clearance at the rear and at least one inch for each side. Failure to provide adequate air clearance will result in excessive internal temperature reducing instrument reliability. The clearances provided by the plastic feet in bench stacking and the filler strip in rack mounting allow air passage across the top and bottom cabinet surfaces.

NOTE

Rack Mount side slide assemblies cannot be used with the 3335A. These assemblies block air passage to the fan and will cause overheating.

2-24. Thermal Cutout Switch.

2-25. The 3335A is equipped with a thermal cutout switch which automatically removes line voltage when the internal temperature becomes excessive. The switch resets automatically when the instrument cools. If a thermal cutout occurs, check for an inoperative fan, clogged fan parts or filter and other conditions that could obstruct air flow. To clean the fan filter, the side panel/filter assembly must be removed. Flush the filter with soapy water, rinse clean and air dry.

2-26. Bench Operation.

2-27. The instrument has plastic feet attached to the bottom panel. The front feet contain foldaway tilt stands for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel. The plastic feet are shaped to make full-width modular instruments self-align when they are stacked. A front handle kit, -hp- Part No. 5060-9899 (Option 907), can be installed for ease of handling the instrument on the bench (see Figure 2-3). The kit is shipped with the instrument if Option 907 is also ordered. Otherwise, the front handle kit is available separately by its -hp- part number.

2-28. Rack Mounting.

2-29. The 3335A can be rack mounted in a rack having an EIA standard width of 482.6 mm (19 inches). The instru-

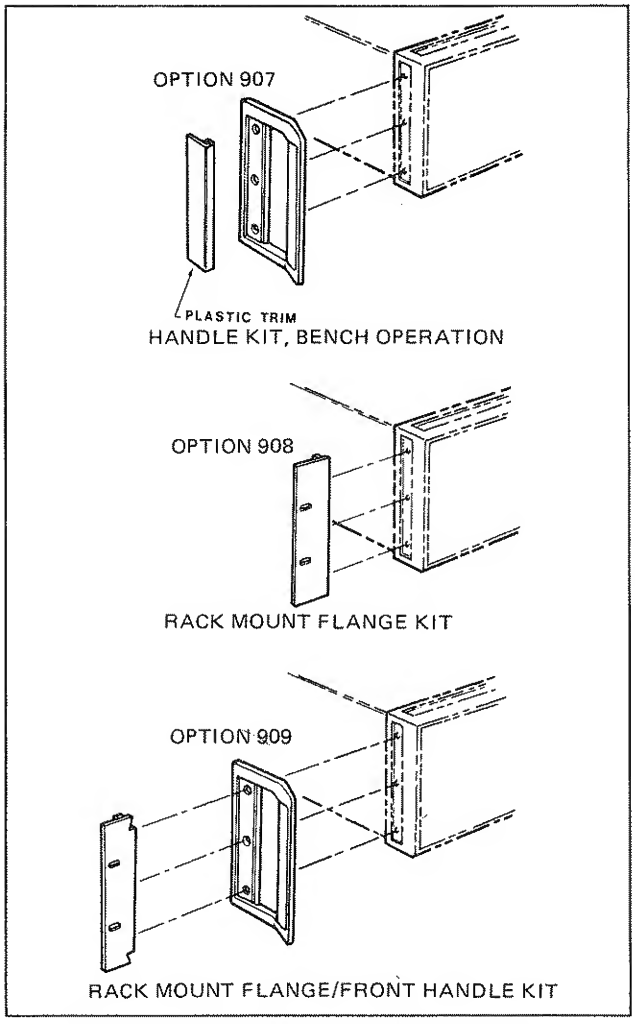


Figure 2-3. Rack Mount and Handle Kits.

ment can be rack mounted with or without a handle kit by use of the following items:

a. Rack mounting without handles: use Rack Mount Flange Kit -hp- Part No. 5061-0077 (Option 908).

b. Rack mounting with handles: use the combination Rack Mount Flange/Front Handle Kit -hp- Part No. 5061-0083 (Option 909).

NOTE

The Rack Mount Flange Kit of item a will not provide the space requirement for rack mounting when used with the bench handle assembly (-hp- Part No. 5060-9899, Option 907). To rack mount with handles, the combination kit of item b (Option 909) must be used (see Figure 2-3). If either Option 908 or 909 is ordered, the corresponding kit is shipped with the instrument. Otherwise, both kits are available separately by their -hp- part numbers.

CAUTION

If instrument is to be rack mounted, do not install standard slide kit. Use of a slide kit blocks air passage to the side mounted fan and will cause excessive heating to occur within the instrument.

2-30. STORAGE AND SHIPMENT.

2-31. Environment.

2-32. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature . . . . . -40°C to +75°C
Humidity . . . . . < 95% relative
Altitude . . . . . < 25,000 feet

2-33. Packaging.

2-34. Original Packaging. Containers and materials equivalent to that used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-35. Other Packaging. The following general instructions should be used for repackaging with commercially available materials.

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A doublewall carton made of 250-pound test material is adequate.

c. Use enough shock-absorbing material (3-to-4 inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains operating and programming instructions for the -hp- Model 3335A Synthesizer/Level Generator. Included is a description of controls, connectors and indicators, operating instructions and operator's maintenance. A list of operating features is tabulated in Table 3-1 which can be used as an index to locate operating information.

3-3. PANEL FEATURES.

3-4. Figure 3-2 illustrates and describes the function of all front and rear panel controls, connectors and indicators. Items requiring additional description are referenced to paragraphs in the operating instructions.

3-5. OPERATOR'S MAINTENANCE.

3-6. Operator's maintenance of the -hp- Model 3335A Synthesizer/Level Generator is limited to rear panel power line fuse replacement.

CAUTION

When replacing fuses, always verify the replacement fuse is of the correct amperage and is FAST-BLO.

3-7. POWER/WARM-UP.

3-8. The Model 3335A Synthesizer/Level Generator requires a power source of 100, 120, 220 or 240 V ac, + 5%, - 10%, 48 to 66 Hz single phase. The selection of line voltage and input power fuse is described in Section II, Paragraph 2-5, PREPARATION FOR USE.

3-9. The 3335A has a two-position power switch, STBY and ON. It is important that the instrument remain connected to the power source in the STBY mode when not in use. This supplies power to the crystal oven maintaining a constant oven temperature thus eliminating the need for a long warm-up period. When the STBY mode is not used and power is disconnected from the instrument, allow 30 minutes from the application of external power in the ON mode for the instrument to warm up.

3-10. Modes of Operation.

3-11. There are two manual modes of operation and an automatic sweep mode of operation for the Model 3335A Synthesizer/Level Generator. One manual mode is manual tune operation allowing the user to manually tune any frequency in the 3335A's range. The other manual mode is the manual sweep mode which allows the user to manually sweep the frequency between predetermined end points. The automatic sweep mode allows the user to initiate a single sweep or a continuous sweeping output. The automatic sweep modes are remotely programmable through the HP-IB.

3-12. OPERATING INSTRUCTIONS.

3-13. Operating the Model 3335A Synthesizer/Level Generator requires programming the operating parameters by use of front panel keys. These keys are contained in four major groupings. From left to right across the front panel the groups are:

Table 3-1. Operating Information Index.

Operating Item	Paragraph
Frequency Entry	3-26
Frequency Increment Entry	3-28
Amplitude Entry	3-30
Amplitude Increment Entry	3-33
Phase Increment Entry	3-35
Phase/Phase Increment Displays	3-37
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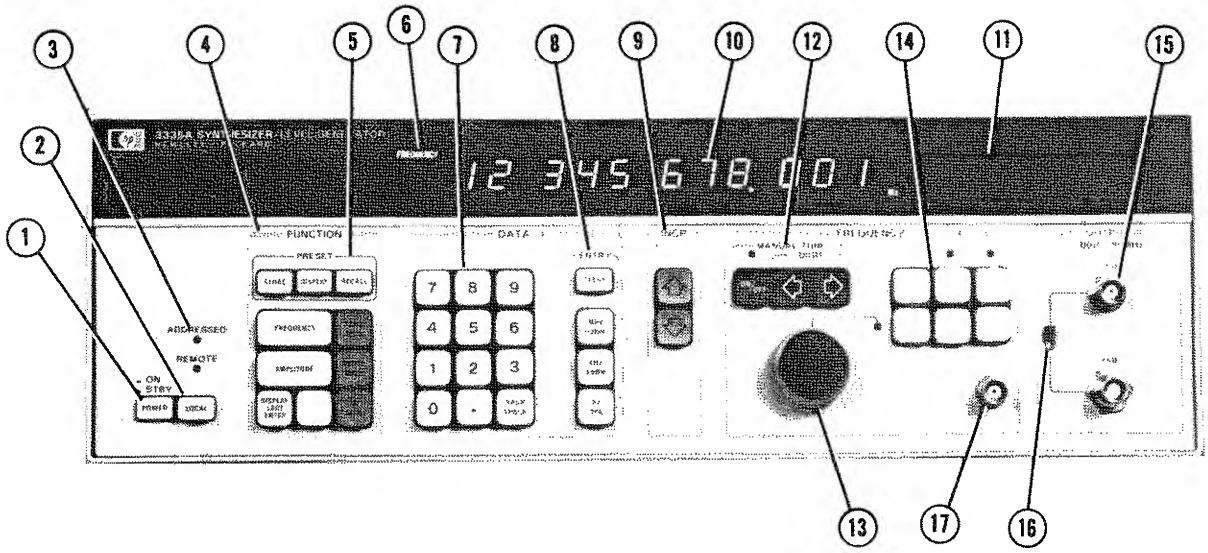
a. FUNCTION
b. DATA
c. INCR
d. FREQUENCY

3-14. FUNCTION Keys.

3-15. The FUNCTION keys control which operating parameter is displayed. Within the FUNCTION group is a subgroup called PRESET. This subgroup controls ten storage registers each capable of storing all of the operating parameters of the FUNCTION group. This is useful for recalling a particular set of operating parameters without having to enter each one.

3-16. DATA Keys.

3-17. The DATA keys are used to enter a new operating parameter which is selected by the FUNCTION keys. This group contains a subgroup called ENTRY. The ENTRY



(1) POWER Switch. A two position switch (ON and STBY) for controlling line power. In the STBY position, power is applied to the internal temperature-stabilized crystal oven to maintain the operating temperature. This eliminates the need for long warm-up periods when the instrument is turned on. Additionally, unregulated 8 V is present on the Controller and Attenuator Driver Assemblies in the STBY mode.

(2) LOCAL Switch. Returns the instrument to local control when operated remotely and Local Lockout command has not been issued.

(3) HP-IB Annunciators. Indicates when the instrument is under remote control and if it is addressed to listen.

(4) FUNCTION Keys. Used to display a particular operating parameter or preface a data entry.

(5) PRESET Keys. Provide access to ten storage registers each capable of storing all operating parameters of the FUNCTION group.

(6) Annunciator Group 1. Indicates the operating parameter being displayed. Annunciators consist of CENTER, FREQUENCY, SWP WIDTH, AMPLITUDE, Ø and INCR.

(7) DATA Keys. Used to make data entries.

(8) DATA ENTRY Keys. Used to complete a data entry.

(9) INCR Keys. Used to initiate a frequency, amplitude or phase increment.

(10) Numeric Display. Indicates the magnitude (and polarity if applicable) of the parameter being displayed.

(11) Annunciator Group 2. Indicates the units of the operating parameter displayed (MHz, kHz, Hz, dBm or deg). Also contains the annunciators ENTRY, UNLOCKED, SWEEPING and UNLEVELED.

(12) Manual Tune Keys. Initiates the manual tune frequency mode and establishes the degree of resolution of the manual tuning.

(13) Frequency Tune Knob. Used to manually alter the frequency when in the manual tune or manual sweep mode.

(14) Sweep Keys. Initiates and controls the frequency sweep mode of operation.

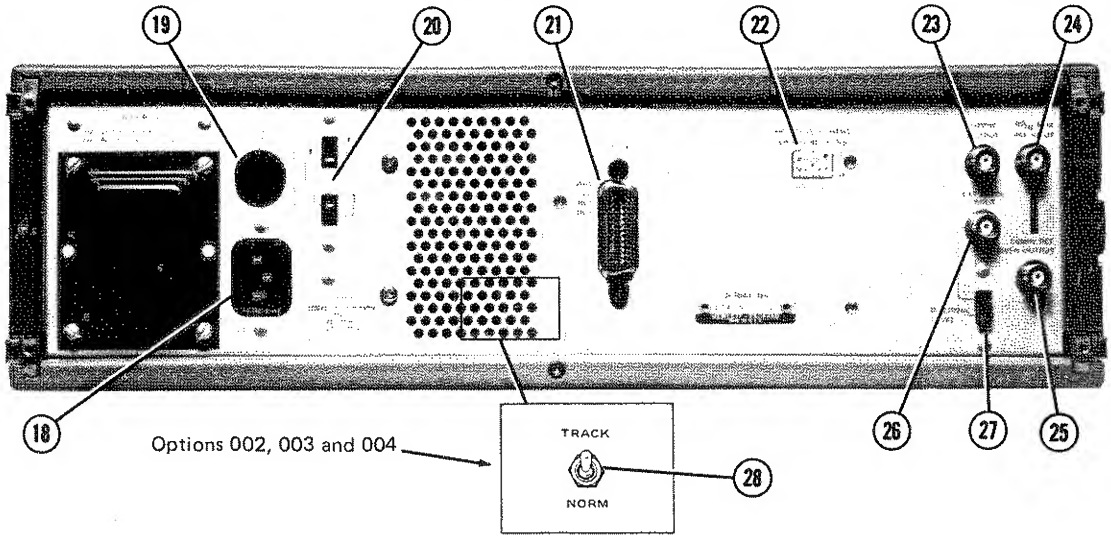
(15) Output Connectors. Provides the programmed output at the output impedance selected by the front panel impedance switch.

(16) Impedance Switch. Used to select the desired output impedance. This switch determines which output connector (item 15) is active.

(17) SWEEP OUTPUT Connector. Provides a 0 to + 2 V dc sweep ramp for use in driving external equipment (oscilloscope, X–Y recorder, etc.) when in the sweep mode.

⚠ Symbol. This symbol is an international symbol meaning "refer to the Operating and Service Manual". This symbol appears in this section of the manual flagging operating instruction information.

Figure 3-1. Front and Rear Panels.



(18) AC Line Input Connector.

(19) AC Line Fuse.

(20) Line Voltage Selection Switches. Used to select the ac line input for the voltage of the power source.

(21) HP-IB Connector. Used to interface the instrument with the HP-IB for remote operation.

(22) HP-IB Listen Address Selection Switches. Used to set the instrument listen address.

(23) 10 MHz OUTPUT Connector. Provides a 10 MHz external reference signal generated by the instrument's reference section.

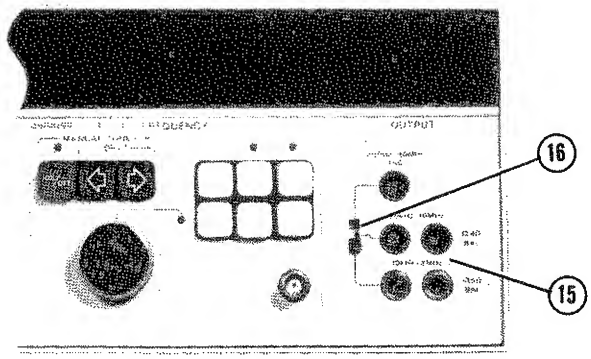
(24) 40/N MHz REF INPUT Connector. Provides the input to the reference section sampling detector to phase-lock the master oscillator. The notation 40/N MHz means this input must be a subharmonic of 40 MHz. The input can be the internal 10 MHz crystal oscillator from the REF OUTPUT (item 25) or an external standard.

(25) 10 MHz REF OVEN OUTPUT Connector. Provides the output from the temperature-stabilized crystal oscillator. It is coupled to the 40/N MHz INPUT connector (item 24) to supply the reference signal when an external standard is not used.

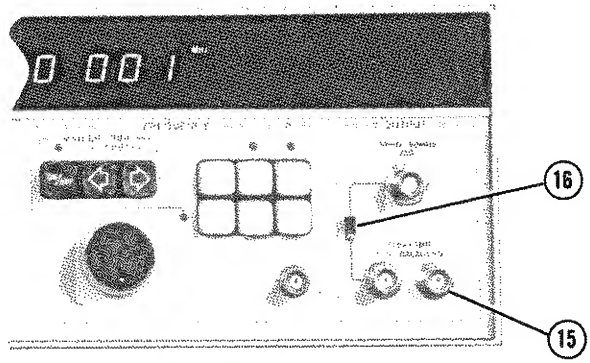
(26) EXT LEVEL INPUT Connector. Provides a means of controlling amplitude by use of an external amplitude reference.

(27) LEVELING Switch. Activates the EXT LEVEL INPUT when in the top position. When in the INTERNAL LEVEL position, leveling is controlled by the instrument.

(28) TELECOMMUNICATIONS SWEEP Switch. In Track position, alters the AUTO sweep by slowing it to ≈ 4 sec per step and blanking the amplitude during frequency changes. (Options 002, 003 and 004 only.)



Option 002/004: Front Panel.



Option 003: Front Panel

Figure 3-1. Front and Rear Panels (Cont'd).

keys are used to complete a data entry or to clear an entry made in error. The FUNCTION and DATA groups together are used to program the operating parameters.

3-18. INCR Keys.

3-19. There are two keys in the INCR group—an arrow up and an arrow down. These keys are used to increment the frequency, amplitude or phase (whichever function is displayed), by the increment parameter programmed from the FUNCTION group. The key pressed determines the direction the increment is made.

3-20. FREQUENCY Keys.

3-21. The FREQUENCY keys are divided into two sub-

groups, MANUAL TUNE and SWEEP. Below the MANUAL TUNE keys is a tuning knob. When the MANUAL TUNE function is selected, a "flashing" digit appears on the display. The left and right arrow digit keys can be used to select any digit to be the "flashing" digit. Turning the knob changes the frequency by the resolution of the "flashing" digit.

3-22. The SWEEP subgroup allows the frequency to automatically sweep a programmed set of frequencies determined by the frequency of operation (center frequency) and the SWEEP WIDTH programmed from the FUNCTION group. A manual sweep mode allows the user to manually sweep the programmed set of frequencies. To return to keyboard operation of the other key groups, the STOP key in the SWEEP subgroup must be pressed.

3-23. Turn-On Operating Parameters.

3-24. When the Model 3335A is turned on, the output parameters of the FUNCTION group initially are:

Frequency	1 000 000. 0 Hz
Amplitude	- 86.98 dBm (50 Ω) - 88.74 dBm (75 Ω)
FREQ INCR	1.0 Hz
AMPTD INCR	1.0 dB (Note: For AMPTD INCR display, the annunciator dBm is used for dB)
∅ INCR	1.0 deg
SWEEP WIDTH	100.0 Hz

3-25. The 3335A turns on with the frequency displayed. To check the initial conditions of the other operating parameters, press the key in the FUNCTION group of the parameter of interest. The display should indicate the initial conditions stated in the preceding paragraph. If the instrument was not previously connected to a power source and in STBY, the out-of-lock annunciator "UNLOCKED" will be displayed until the reference oven temperature stabilizes (< 20 minutes). If "UNLOCKED" is still displayed after twenty minutes, check to be sure the BNC-to-BNC adapter from the 10 MHz REF OVEN OUTPUT connector to the 40/N MHz Ref Input has been installed (see Figure 6-2, Item 25).

3-26. Frequency Entry.

3-27. The 3335A has a frequency range of 200 Hz to 80 099 999. 999 Hz with resolution of 0.001 Hz. The desired output frequency is programmed by activating the FREQUENCY FUNCTION key, DATA keys 0 through 9 and a DATA ENTRY key Hz, kHz or MHz. A description of these keys and the frequency display indicators follows.

NOTE

For the following Operating Instructions, refer to Figure 3-1.

FREQUENCY Key. Preface key for entering frequency. When pressed, the front panel displays the present output frequency and the controller is enabled to accept new frequency data.

DATA Keys. These keys are used to enter the desired frequency. Notice that when data is entered, the digits enter the display from right to left. Holding a digit key down causes that digit to be entered respectively. If a wrong digit is entered, press the BACK SPACE key and the right-most digit of the display (the last digit entered) will be deleted. Continue with the correct entry.

DATA ENTRY Keys. If an entry is completely in error, the CLEAR key can be used to reset the display entry to zero. The correct entry can then be made. An entry is finalized by pressing one of the three range keys. The display changes to indicate the new output frequency. If an illegal entry has been finalized, the output frequency does not change and the display flashes.

DISPLAY INDICATORS:

FREQUENCY Indicator. Indicates the front panel is displaying the output frequency or a frequency entry.

ENTRY Indicator. Indicates the front panel is not displaying the output frequency but holding a frequency entry that has not yet been finalized by a data entry key.

The numeric display indicates the output frequency programmed. The digits are entered from right to left as frequency digits are keyed in. The frequency can be displayed in Hz, kHz or MHz dependent on which range key is pressed. The units of the display can be changed at any time by pressing the desired range key.

Example:

Program a frequency of 12345678.901 Hz

Display Result: 12 345 678.901 Hz

Change units to kHz: Press kHz ENTRY key.

Display Result: 12 345.678 901 kHz

Change units to MHz: Press MHz ENTRY key.

Display Result: 12.345 678 901 MHz

NOTE

If the front panel is displaying frequency, it is not necessary to preface a frequency entry with the FREQUENCY key.

3-28. Frequency Increment Entry.

3-29. Frequency increment is used when it is desired to manually change the frequency by a specified increment. The desired frequency increment is programmed by activating the FREQ INCR FUNCTION key, DATA keys 0 through 9 and a DATA ENTRY key Hz, kHz or MHz just as the frequency was programmed. A frequency increment of zero (no increment) can be programmed while the maxi-

mum increment programmable is the maximum output frequency of 80 099 999. 999 Hz. Trying to program an increment greater than the maximum results in a flashing display indicating an illegal entry. To change the output frequency by the programmed increment, the INCR keys are activated incrementing the frequency either up or down. A description of the keys and frequency step display indicators follows.

KEYS:

FREQ INCR Key. Preface key for entering frequency increment. When pressed, the front panel displays the present frequency increment and the controller is enabled to accept new frequency increment data.

DATA Keys. Used to enter the desired frequency increment.

DATA ENTRY Keys. Used to finalize the frequency increment entry. If an increment is programmed that exceeds the maximum, the display flashes indicating an illegal entry.

INCR Keys. These keys are used to change the output frequency by the programmed increment. The frequency can be incremented either up or down dependent upon the INCR key activated. If an INCR key is held activated, the frequency continues to be incremented providing a step frequency sweep. The magnitude of each step is determined by the frequency increment programmed.

DISPLAY INDICATORS:

FREQUENCY INCR Indicator. Indicates the front panel is displaying the present frequency increment or a frequency increment entry.

ENTRY INDICATOR. Indicates the display holds a frequency increment entry not yet finalized by a data entry key.

The numeric display indicates the frequency increment programmed. Can be displayed in kHz or MHz by pressing the desired range key.

Example:

Program a frequency increment of 12500 Hz.

Display Result: 12 500. 0 Hz

Display present frequency by pressing FREQUENCY FUNCTION key.

Display Result: Present frequency is displayed.

NOTE

This step can be omitted and the frequency incremented by pressing an INCR key even though FREQ INCR is displayed.

Increment the frequency by pressing the INCR down arrow.

Display Result: Present frequency is decreased by 12 500.0 Hz

Return to initial frequency by pressing the INCR up arrow.

Display Result: Initial frequency is displayed.

NOTE

If the front panel is displaying frequency increment, it is not necessary to preface a frequency increment entry with the FREQ INCR key.

3-30. Amplitude Entry.

3-31. The 3335A Amplitude limits are determined by the output impedance selected. In the standard instrument a 50 ohm or 75 ohm output impedance can be chosen. With a 50 ohm output, the amplitude range is - 86.98 dBm to + 13.01 dBm. For a 75 ohm output, the amplitude range is - 88.74 dBm to + 11.25 dBm. Any amplitude within the range can be programmed with 0.01 dBm resolution. For option 002, 003 or 004 instrument amplitude ranges, refer to Table 1-2, General Information.

3-32. The desired output amplitude is programmed by activating the AMPLITUDE FUNCTION key, DATA keys 0 through 9 and a DATA ENTRY key - dBm or + dBm. A description of these keys and the amplitude display indicators follows:

KEYS:

AMPLITUDE Key. Preface key for entering amplitude. When pressed, the display indicates the present output amplitude and the controller is enabled to accept new amplitude data.

DATA Keys. These keys are used to enter the desired amplitude.

DATA ENTRY Keys. Used to finalize the amplitude entry. If an amplitude is programmed which exceeds the range of the instrument, the output amplitude does not change and the display flashes.

DISPLAY INDICATORS:

AMPLITUDE Indicator. Indicates the front panel is displaying the present output amplitude or an amplitude entry.

ENTRY Indicator. Indicates the display holds an amplitude entry not yet finalized by a data entry key.

The numeric display indicates the amplitude programmed.

Example:

Program an amplitude of - 23.45 dBm.

Display Result: - 23.45 dBm

NOTE

1. It is normal to hear relay operation when the attenuator changes attenuator pads.

2. If the front panel is displaying amplitude, it is not necessary to preface and amplitude entry with the AMPLITUDE key.

3. With a negative amplitude displayed, depressing the BACK SPACE key will cause an ENTRY preceded by a negative sign. With this type of amplitude entry displayed, the "–dBm" and "+dBm" entry keys will both finalize a negative amplitude.

3-33. Amplitude Increment Entry.

3-34. Amplitude increment is used when it is desired to manually change the amplitude by specific increments. The desired amplitude increment is programmed by activating the AMPTD INCR FUNCTION key, DATA keys 0 through 9 and a DATA ENTRY key, - dBm or + dBm. If an amplitude increment greater than 99.99 dBm is programmed, the display flashes indicating an illegal entry. A description of the keys and amplitude increment display indicators follows.

KEYS:

AMPTD INCR Key. Preface key for entering amplitude increment. When pressed, the front panel displays the present amplitude increment and the controller is enabled to accept new amplitude increment data.

DATA Keys. These keys are used to enter the desired amplitude increment.

DATA ENTRY Keys. Used to finalize the amplitude increment entry. If an increment is programmed that exceeds the maximum, the display flashes indicating an illegal entry.

INCR Keys. These keys are used to change the output amplitude by the programmed increment. By holding an INCR key activated, the amplitude can be stepped through an amplitude sweep.

DISPLAY INDICATORS:

AMPLITUDE INCR Indicator. Indicates the front panel is displaying the present amplitude increment or an amplitude increment entry.

ENTRY Indicator. Indicates the display holds an amplitude increment entry not yet finalized by a data entry key. The numeric display indicates the amplitude increment programmed.

NOTE

Amplitude increment is actually in dB but the dBm annunciator is used.

Example:

Program an amplitude increment of + 2.75 dBm.

Display Result: 2.75 dBm

Display present amplitude, press AMPLITUDE FUNCTION key.

Display Result: Present Amplitude display

Increment amplitude by pressing the INCR up arrow.

Display Result: Present amplitude is incremented by 2.75 dBm.

3-35. Phase Increment Entry.

3-36. The phase increment can be used to change the output phase relationship with respect to another signal by a fixed phase increment. As an example, the 10 MHz rear panel output and the front panel output signal have a certain phase difference at turn-on. By phase incrementing the output, the output signal will increase or decrease the initial phase difference by the magnitude of the phase increment programmed. An example of using the phase increment function is illustrated in the integrated phase noise test of Section V. The desired phase increment is programmed by activating the ∅ INCR FUNCTION key, DATA keys 0 through 9 and the deg DATA ENTRY key. An increment range of 0 degree to 360 degrees is obtainable with a resolution of 0.1 degree. Any increment attempted greater than 360 degrees causes the display to flash indicating an illegal entry. A description of the keys and the ∅ and ∅ increment displays follows.

KEYS:

∅ INCR Key. Preface key for entering phase increment. When pressed, the front panel displays the present phase increment and the controller is enabled to accept new phase increment data.

DATA Keys. These keys are used to enter the desired phase increment.

DATA ENTRY Key. Used to initialize the phase increment entry. If an increment is entered exceeding 360 degrees, the display flashes when the ENTRY key is pressed.

DISPLAY INDICATORS:

∅ INCR Indicator. Indicates the front panel is displaying the present phase increment or a phase increment entry.

Ø Indicator. Indicates the phase difference introduced with respect to the initial phase of the present frequency. This indicator appears when an INCR key is pressed when Ø INCR is displayed.

ENTRY Indicator. Indicates the display holds a phase increment entry not yet finalized by a data entry key.

The display indicates the phase increment programmed.

Example:

Program a phase increment of 45.0 degrees.

Display Result: 45.0 deg

Press the INCR up arrow two (2) times.

Display Result: Display annunciator shows Ø and display shows 90.0 deg.

NOTE

If an INCR key is held, the output is phase incremented continuously.

3-37. Phase/Phase Increment Displays.

3-38. When the display indicates the Ø difference introduced by the phase increment and a new phase increment entry is made which is not prefaced by the Ø INCR key, the display automatically reverts to a Ø INCR display. The entry can be finalized like any other phase increment entry. Therefore, if the display is indicating phase, a phase increment entry need not be prefaced by the Ø INCR key.

3-39. Preset Entries.

3-40. All operating parameters of the FUNCTION group can be stored in one of ten PRESET registers. The ten registers are numbered 0 through 9 and are capable of storing ten different sets of the operating parameter's frequency, amplitude, frequency increment, amplitude increment, phase increment and sweep width. At turn-on, all registers contain the turn-on operating parameters. The PRESET keys which control the registers are STORE, DISPLAY and RECALL. A description of the PRESET keys follows.

KEYS:

STORE Key. Used to store the operating parameters of the front panel output. The digit key of the register to store the parameters must be pressed following the STORE key. This stores the operating parameters frequency, amplitude, frequency increment, amplitude increment, phase increment, sweep width, and the state of the manual tune control without affecting the output signal.

RECALL Key. Used to recall the operating parameters of a particular register. The digit key of the register containing the operating parameters desired must be pressed following the RECALL key. This changes the amplitude and frequency of the output signal to that stored in the register. It also changes all other FUNCTION parameters to that stored in the register (e.g., AMPTD INCR, FREQ INCR, Ø INCR and SWEEP WIDTH).

DISPLAY keys. Used to display a particular operating parameter stored in a register. Displaying a parameter does not change the output signal but is displayed as an entry. This entry can be finalized by pressing a DATA ENTRY key.

Example.

Preset the following operating parameters in storage register 2.

FREQUENCY	2 MHz
AMPLITUDE	2 dBm
FREQ INCR	200 Hz
AMPTD INCR	0.2 dBm
Ø INCR	2 degrees
SWEEP WIDTH	2 kHz

Preset the following operating parameters in storage register 3.

FREQUENCY	3 MHz
AMPLITUDE	3 dBm
FREQ INCR	300 Hz
AMPTD INCR	0.3 dBm
Ø INCR	3 deg
SWEEP WIDTH	3 kHz

First program all parameters; then press STORE 2.

NOTE

In the examples for STORE 2 and STORE 3, different parameters are displayed when the STORE key is pressed to preset the register. SWEEP WIDTH is displayed when STORE 2 is pressed. ϕ INCR is displayed when STORE 3 is displayed. In the next two examples, the RECALL function is illustrated. When data is recalled from a preset register, the parameter displayed when that register was preset is the parameter returned to the display. In the case of RECALL 2, SWEEP WIDTH will be returned to the display. All other parameters will be changed to that preset in register 2. For the RECALL 3 case, ϕ INCR will be returned to the display. All other parameters will be changed to that preset in register 3.

Recall parameters of register 2 by pressing RECALL 2.

Result: Display indicates SWEEP WIDTH of 2.0 kHz. When this set of parameters was stored, SWEEP WIDTH was last displayed. When recalled, the parameter last displayed at STORE is returned to the display.

Check the other operating parameters in register 2 by pressing their respective FUNCTION key. The display should indicate the quantities previously programmed.

Recall the operating parameters of register 3 by pressing RECALL 3.

Result: Display indicates ∅ INCR of 3.0 deg (∅ INCR was the parameter displayed when STORE 3 was initiated).

Check other operating parameters in register 3 as previously done for register 2.

Display the frequency of register 2 without changing the output frequency by pressing DISPLAY, FREQUENCY, 2.

Display Result: FREQUENCY 2 000 000. 0 ENTRY (This frequency can be initiated by activating a DATA ENTRY key.)

Initiate by pressing the Hz DATA ENTRY key.

Display result: 2 000 000. 0 Hz

Recall the operating parameters of register 4 by pressing RECALL 4.

Result: FREQUENCY 1 000 000. 0 Hz (This is an initial turn-on condition. The other operating parameters stored in register 4 are also initial conditions. When a register containing initial conditions is recalled, FREQUENCY is displayed.)

3-41. Merging Data Into a Preset Register.

3-42. Any operating parameter stored in a PRESET register can be changed by merging the new parameter into the register without changing the other parameters of the stored sets. This allows the user to change a parameter in a PRESET register and only be concerned with the parameter being changed. Merging a parameter is done much like storing a complete parameter set as described in the preceding paragraph. The difference is the function key, corresponding to the parameter to be merged, is pressed prior to the register number key. Several examples of merging data follow.

EXAMPLE:

Recall from the previous examples that all parameters in PRESET register 2 contain two's and those in PRESET register 3 contain three's.

Change the frequency in PRESET register 2 to 4 MHz and the amplitude increment of register 3 to 0.6 dBm by pressing FREQUENCY, 4 MHz, STORE, FREQUENCY, 2 an and AMPTD INCR, 0.6, + dBm, STORE AMPTD INCR, 3.

Verify these parameters have been merged by displaying each parameter after recalling registers 2 and 3.

3-43. Recalling Data From a Preset Register.

3-44. Any operating parameter stored in a PRESET register can be recalled individually without recalling the entire parameter set. This allows the user to change an output parameter by recalling only that parameter from one of the ten PRESET registers. This is done like the merging of data. The function key, corresponding to the parameter to be recalled, is pressed prior to the register number key. Several examples of recalling a single parameter follow.

EXAMPLE:

Press RECALL 5.

Display Result: Display indicates a frequency of 1 MHz and all operating parameters are initial conditions.

Recall the frequency increment of PRESET register 2 by pressing RECALL, FREQ INCR, 2.

Display Result: Display indicates a frequency increment of 200 Hz. All other parameters are still initial conditions.

Recall the amplitude of PRESET register 3 by pressing RECALL, AMPLITUDE, 3.

Display Result: Display indicates amplitude of + 3 dBm. All other parameters except frequency increment are initial conditions. Frequency increment is 200 Hz.

3-45. Display Last Entry.

3-46. The DISPLAY LAST ENTRY KEY of the FUNCTION group is used to recall to the display the last entry made. It will not recall the function the entry was made in but only the digits. If an operating parameter from one of the ten storage registers is displayed as an entry by activating the DISPLAY key of the PRESET FUNCTION keys, it becomes the last entry. Conversely, when the CLEAR key is pressed, the display shows an entry of zero but this does not constitute a last entry. This is because a display entry cleared in error can be recalled by pressing the DISPLAY LAST ENTRY key.

3-47. Sweep Width Entry.

3-48. In the sweep mode, the 3335A frequency can be swept over a specific range. The operating frequency before the sweep mode is the center frequency of the sweep. The starting point of the sweep is determined by the sweep width programmed. Half the sweep occurs below the center frequency and half above the center frequency. The sweep width is programmed by activating the SWEEP WIDTH FUNCTION key, DATA keys 0 through 9 and a DATA ENTRY key Hz, kHz or MHz. Programming a sweep width greater than the instrument's capability causes the display to flash indicating an illegal sweep. A description of the keys and the sweep width display indicators follows.

KEYS:

SWEEP WIDTH Key. Preface key for entering sweep width. When pressed the front panel displays the present sweep width and the controller is enabled to accept new sweep width data.

DATA Keys. These keys are used to enter the desired sweep width.

DATA ENTRY Keys. Used to finalize the sweep width entry.

DISPLAY INDICATORS:

SWEEP WIDTH Indicator. Indicates the front panel is displaying the present sweep width or a sweep width entry.

ENTRY Indicator. Indicates the display holds a sweep width entry not yet finalized by a data entry key.

The numeric display indicates the sweep width programmed.

Example:

Program a sweep width of 580.34 kHz

Display Result: 580.34 kHz.

3-49. Manual Frequency Tune.

3-50. The frequency can be manually altered in the manual tune mode. The frequency change is controlled by a front panel frequency knob. The 3335A can be put in the manual tune mode by the MANUAL TUNE ON/OFF key. When the manual tune key is activated, an annunciator above the key is illuminated.

3-51. In addition to the ON/OFF key, the MANUAL TUNE controls include two digit keys, a left arrow and a right arrow. These keys are used to select the sensitivity of the manual tune knob. When the manual tune mode is first activated, the fourth digit from the right flashes. The frequency can be changed with the sensitivity of the flashing digit by turning the frequency knob. For more or less sensitivity, the flashing digit can be moved using the left and right digit arrows. Holding an arrow key down causes the flashing digit to step successively to the end digit. When in the MANUAL TUNE mode, the frequency can be incremented by the frequency increment using the INCR keys and all operating parameters can be checked using the FUNCTION keys. A description of the MANUAL TUNE controls follows.

KEYS:

MANUAL TUNE ON/OFF. This key activates the manual tune mode. When on, an annunciator above the key is illuminated.

LEFT ARROW Digit Key. Steps flashing digit to the left.

RIGHT ARROW Digit Key. Steps flashing digit to the right.

Frequency manual tune knob. Used to change the frequency with the sensitivity of the flashing digit.

3-52. Sweep Mode.

3-53. The sweep mode can be used to sweep the output frequency over a specified center frequency. This mode of operation is controlled by the FREQUENCY SWEEP keys which include GO TO START FREQ, START SINGLE 10 SEC, START SINGLE 50 SEC, MANUAL, START AUTO and STOP. A SWEEP OUTPUT connector below the keys provides an output proportional to the sweep frequency for use with a plotter. The frequencies of a frequency sweep are determined by the sweep width and center frequency. The sweep rate in AUTO is approximately 8 sweeps/second, 100 steps/sweep. In MANUAL, 10 SEC and 50 SEC sweeps, the sweep contains 1000 steps.

NOTE

Whenever the -hp- 3335 sweeps through either 20 MHz or 40 MHz, the amplitude of the output will drop severely for approximately 5 msec. Other, much less drastic amplitude discontinuities may be observed. When the instrument sweeps through 10 MHz, 14 MHz, 28 MHz and 56 MHz.

KEYS:

GO TO START FREQ Key. This key is used to display and output the starting frequency of the sweep. The starting frequency is determined by the center frequency and the sweep width. Half the sweep, determined by the sweep width, is below the center frequency establishing the start frequency.

START SINGLE 10 SEC Key. This key is used to initiate a single sweep beginning at the start frequency below the center frequency. The time for the sweep to go from start to finish is approximately 10 seconds and consists of 1000 steps. When the sweep is in this mode, an annunciator above the key is illuminated. The sweep rate can be changed during the sweep by pressing the 50 SEC key or can be stopped by pressing the STOP key. Pressing the AUTO key will put the sweep into auto sweep. During any sweep, depressing a key outside the frequency sweep group has no effect on operation.

START SINGLE 50 SEC Key. This key is used to initiate a single sweep which requires approximately 50 seconds to complete and consists of 1000 steps.

START AUTO Key. This key is used to initiate the sweep which sweeps continuously from the start frequency to the upper limit. The sweep resets to the start frequency when the upper limit is reached and again sweeps up in frequency at a rate of approximately 8 sweeps/second and 100 steps/sweep. The frequency is only swept in the increasing frequency direction in both the single sweep or auto sweep modes. When the instrument is in the auto sweep mode, the display is blank except for the SWEEPING annunciator. The STOP key must be used to exit an auto sweep.

MANUAL key. This key is used to put the sweep into a manual sweep mode. When activated, an annunciator is illuminated to the left of the MANUAL key. The frequency sweep between the start frequency and upper limit can be manually controlled by the frequency knob making 1000 steps between the two limits. When either the upper limit or start frequency is reached, the manual sweep stops. When the frequency knob is rotated changing the frequency, the display segments and annunciators may dim slightly.

STOP Key. This key is used to stop a single sweep before it is complete or to halt an auto sweep and return to keyboard control. When pressed the frequency is returned to the center frequency which was the frequency of operation prior to activating the sweep mode.

SWEEP OUTPUT: The sweep output provides a dc voltage from 0 to + 2 V. 0 V dc corresponds to the start frequency of the sweep and + 2 V the upper limit. During the sweep the output is proportional to the frequency and can be used to drive the horizontal axis of a plotter or an oscilloscope. When the instrument is not in the sweep mode, the SWEEP OUTPUT is + 1 V dc. When GO TO START FREQ is pressed, the instrument displays the start frequency of the sweep and the SWEEP OUTPUT is 0 V. After a single sweep is complete and the upper limit is displayed, the SWEEP OUTPUT is + 2 V dc. These points can be used to adjust the plotter end points.

DISPLAY INDICATORS:

NOTE

In any sweep mode, the frequency display is in hertz.

CENTER FREQUENCY Indicator. Indicates the front panel is displaying the center frequency of the sweep. When the frequency passes through the center frequency during a sweep, the CENTER annunciator flashes.

SWEEPING Indicator. Indicates the instrument is in the SWEEP mode. If the instrument is not in an active single sweep or in auto sweep (i.e., if it is in manual, at start frequency or at the end of a single sweep), pressing any key on the keyboard out of the sweep group will take the instrument out of the sweep mode.

Example:

Program the Synthesizer to sweep a 500 kHz band centered on 12 500 kHz.

Program the center frequency by programming a frequency of 12 500 kHz.

Display Result: 12500.0 kHz

Program the sweep width by pressing SWEEP WIDTH, 500, kHz.

Display Result: 500.0 kHz

Check START FREQ by pressing GO TO START FREQ.

Display Result: 12 250 000.0 Hz SWEEPING annunciator on.

Initiate a single 10 second sweep by pressing START SINGLE 10 SEC key.

Display Result: Annunciator above key illuminates, display shows frequency sweep which stops at 12 750 000.0 Hz. Sweep time is 10 seconds.

Initiate single 50 second sweep by pressing START SINGLE 50 SEC key.

Display Result: Annunciator above key illuminates, display shows frequency sweep which stops at 12 750 000.0 Hz. Sweep time is 50 seconds.

Initiate an Auto Sweep by pressing START AUTO key.

Display Result: Display blanks except for SWEEPING annunciator. (Instrument is continuously sweeping from start frequency to the upper limit.)

Stop Auto Sweep by pressing STOP key.

Display Result: Instrument returns to the center frequency. Display indicates 12 500. 0 kHz, SWEEPING annunciator extinguishes.

Initiate MANUAL Sweep by pressing MANUAL key.

Display Result: SWEEPING annunciator illuminates again. Annunciator next to MANUAL key illuminates.

Manually Sweep Frequency: Rotate frequency knob.

Display Result: Frequency increases and decreases with CW and CCW rotation of knob. CENTER annunciator flashes when sweep passes through 12 500. 0 kHz (the center frequency).

Press GO TO START FREQ key.

Display Result: 12 250. 0 kHz

Press MANUAL key of SWEEP group.

Display Result: No change in display.

Rotate frequency knob CW.

Display Result: Frequency increases.

Rotate frequency knob CCW.

Display Result: Frequency decreases until 12 250. 0 kHz (start frequency) is reached. Further CCW rotation of knob will not lower the frequency.

NOTE

The same result occurs at the upper limit of the sweep.

Return the instrument to full keyboard control by pressing the STOP key. This will result in returning to the center frequency.

NOTE

The single sweep speed of a sweep in progress can be changed by depressing the other single sweep key. To go from the single sweep mode to the auto sweep mode, it is recommended the STOP key be used to terminate the single sweep prior to activating the auto sweep mode.

3-54. HP-IB Indicators and LOCAL key.

3-55. The keyboard contains two HP-IB annunciators—REMOTE and ADDRESSED. One indicates when the 3335A is under remote control; the other indicates when the 3335A is addressed to listen by the HP-IB controller.

If the 3335A is under remote control, it can be returned to local control (control by keyboard inputs) by activating the LOCAL key providing a local lockout command has not been sent by the HP-IB system controller.

3-56. Front Panel Output Connectors.

The output of the -hp- 3335A is directly coupled. Do not allow external dc currents to develop more than 5 volts across the output terminals. For Option 002/004 and Option 003 the dc voltage across the output should not be greater than 10 volts.

3-57. The front panel contains the instrument output connectors located in the right-most group labeled OUTPUT and the SWEEP OUTPUT located in the FREQUENCY group. The output connectors provide the programmed output. The SWEEP OUTPUT provides a dc voltage between 0 and + 2 V proportional to the sweep when the Synthesizer is in the sweep mode. When not in the sweep mode the SWEEP OUTPUT is + 1 V. During the sweep, the SWEEP OUTPUT is proportional to the frequency and can be used to drive the horizontal sweep of a plotter or an oscilloscope.

3-58. Rear Panel BNC Connectors.

3-59. 40/N Input. This is the input for the reference frequency that essentially determines the frequency accuracy and stability of the -hp- 3335A. As the name of the input suggests, the reference frequency must be an integral sub multiple of 40 MHz (i.e., 40, 20, 13.333, 10, etc.). The 40 MHz master oscillator in the -hp- 3335A is phase locked to this signal. Lock will occur with 40/N INPUT levels as low as -7 dBm. When an external frequency reference is not used, the 10 MHz REFerence OVEN OUTPUT is coupled to this input with the BNC-to-BNC adapter.

3-60. 10 MHz REFerence OVEN OUTPUT. This is a reference frequency that is coupled to the 40/N INPUT whenever an external frequency reference is not used. When it is used, its accuracy and stability determine the accuracy and stability of the -hp- 3335A output frequency. The parameters of this output are described in Table 1-1. They depend on the Option selected.

3-61. 10 MHz OUTPUT. This output is used to lock the phase of other synthesizers to the phase of the -hp- 3335A. Its output level and output impedance are typically around 0 dBm and 50 ohms.

3-62. EXTernal LEVEL INPUT. This input is selected using the INTERNAL LEVEL/EXT LEVEL INPUT switch located on the rear panel. When it is selected, the dc level on this input determines the output amplitude. The sensitivity is non-linear, however, it is typically about .5 V rms output per dc volt input. With 0 volts dc on this input, the maximum output amplitude of the -hp- 3335A is nominally .5 volts rms into 50 ohms (or 75 ohms). An "UNLEVELED" annunciator on the front panel will light whenever this input is selected.

3-63. Remote Programming.

3-64. This part of Section III contains a brief description of the HP–IB operation and includes programming information for operating the Model 3335A on the HP–IB. It also includes information on the HP–IB connector, HP–IB logic levels and programming codes.

3-65. The HP–IB. The HP–IB is a carefully defined instrumentation interface which simplifies the integration of instruments, calculators and computers into systems. The 3335A is a fully programmable instrument interfacing with the HP–IB by means of a rear panel HP–IB connector (see Figure 3-1). The HP–IB connector is directly compatible with the mating connectors on the -hp- 10631 (A, B or C) HP–IB Cable Assemblies.

3-66. HP–IB Logic Levels. The 3335A HP–IB lines use standard TTL levels and are low-true. The logic levels are:

Low = digital ground or 0 V to +0.4 V dc
High = open or +2.5 V dc to +5 V dc

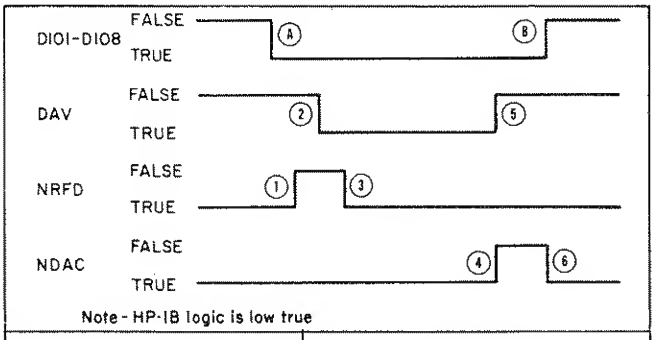
3-67. Isolation. The 3335A is located from the HP–IB by optical couplers. The components located on the HP–IB side of the optical couplers are powered by a separate + 5 V power supply deriving power from an ungrounded secondary transformer winding. This provides isolation of the instrument from the bus.

3-68. Capability. The capability of a device connected to the HP–IB is specified by its interface functions. The interface functions of the 3335A are listed in Table 3-2 and indicate the particular capability of that function as defined in Appendix C of IEEE Std 488-1975. The interface functions indicate what activity a device will respond to or that which it is capable of initiating. Each item indicating a device capability appears on the rear panel next to the HP–IB connector.

3-69. The instrument will recognize a preset "listen" address and accept bit-parallel, word (byte)-serial ASCII-coded data. All data is received through the Data Input/Output (DIO) lines of the HP–IB. The data transfer is controlled by "handshake" lines DAV, NRFD and NDAC. Figure 3-2 illustrates the "handshake" sequence of events and describes each event during the transfer of data. More detailed information is obtainable by ordering a copy of "Condensed Description of the Hewlett-Packard Interface Bus", -hp- Part No. 59401-90030, Microfiche Part No. 59401-90090.

Table 3-2. Interface Functions.

Identification	Description
SH0	No source handshake capability
AH1	Acceptor handshake capability
T0	No talker capability
L2	Basic listener
SR0	No service request capability
RL1	Remote/Local capability
PP0	No parallel poll capability
DC1	Device clear capability
DT0	No device trigger capability
C0	No controller capability



Note - HP-IB logic is low true

Event	Comment
(A) and (B)	The interval between A and B indicates when one byte of information is on the data lines, DIO1 through DIO8. **NOTE** *For the remainder of this explanation,, the term "data" refers to one byte of information (one seven-bit ASCII character).*
(1) NRFD goes false	Listener indicates he is ready to receive data.
(2) DAV goes true	Source recognizes listener is ready for data, places a new character on theDIO lines and indicates to the listener the data on the DIO lines is valid.
(3) NRFD goes true	Listener recognizes the data is valid and indicates to the source he is not ready for any new data. The listener accepts the data on the DIO lines to store internally after NRFD goes true.
(4) NDAC goes false	The listener indicates to the source that he has stored internally the data on the DIO lines. When the data is stored, internal processing begins.
(5) DAV goes false	Source recognizes that the listener has accepted and stored internally the data on the DIO lines. Source removes the data valid indication by setting DAV false in preparation for placing the next byte of information on the DIO lines.
(6) NDAC goes true	Listener recognizes that the source has acknowledged its acceptance of the data and removes the data accepted indication. Listener continues to process the internally stored data.
(1) NRFD goes false	When the listener completes processing the internally stored data, the, listener sets NRFD false which indicates he is ready to receive the next byte of information.

NOTE: Events (1) through (6) must occur for each byte of information transferred between devices on the HP-IB.

Figure 3-2. HP-IB "Handshake" Sequence of Events.

Table 3-3. Bus Messages.

Function	Message	Description
Device Communications	Data	Transfers device-dependent information from one device to one or more devices on the Bus.
Device Control	Trigger	Causes a group of selected devices to simultaneously initiate a set of device-dependent actions.
	Clear	Causes an instrument to be set to a predefined state (a certain range, function, etc.).
	Remote	Permits selected devices to be set to remote operation, allowing parameters and device characteristics to be controlled by Bus Messages.
	Local	Causes selected devices to return to local (front panel) operation.
	Local Lockout	Disables local (front panel) controls of selected devices.
	Clear Lockout & Local	Returns all devices to local (front panel) control and simultaneously clears the Local Lockout Message.
Interrupt and Device Status	Require Service	Indicates a device's need for interaction with the controller.
	Status Byte	Presents status information of a particular device; one bit indicates whether or not the device currently requires service, the other 7 bits (optional) are used to indicate the type of service required.
	Status Bit	A single bit of device-dependent status information which may be logically combined with status bit information from other devices by the controller.
Passing Control	Pass Control	Passes bus controller responsibilities from the current controller to a device which can assume the Bus supervisory role.
Bail Out	Abort	Unconditionally terminates Bus communications and returns control to the system controller.

3-70. Messages are the means by which devices communicate on the HP–IB. Table 3-3 lists the Bus Messages by Bus function and provides a description of each.

3-71. HP–IB Remote Operation.

3-72. The HP–IB Remote Enable (REN) line controls the instrument's mode of operation, LOCAL or REMOTE. With no input on the REN line, it is held high by an internal pullup maintaining the 3335A in the LOCAL mode of operation. When the 3335A listen address is transmitted, the REN line is pulled low causing it to go into the remote control mode. The REN lines does not have internal storage and must be held in the low state as long as remote operation is required. Once the 3335A has been put into the

REMOTE mode of operation, it can be unaddressed, and it will remain in REMOTE operation until the REN line is released or the LOCAL key is pressed.

3.73. When the REN line is low and the 3335A is addressed, the instrument goes into the REMOTE mode and the following things take place.

a. The front panel REMOTE annunciator lights.

b. The front panel controls (except POWER and the impedance switch) are disabled. When addressed to listen, the 3335A will accept REMOTE instructions.

c. The output parameters established by keyboard control in the LOCAL mode are retained in the REMOTE mode until remotely changed.

3-74. When the HP-IB system controller releases the REN line, the following things take place:

a. The front panel REMOTE annunciator goes out and the 3335A output parameters remain as last programmed in the REMOTE mode of operation.

b. The 3335A will no longer respond to remote instructions. It will respond to its listen address and the unlisten command.

3-75. Addressing to Listen. All instruments using the HP-IB share a common set of data and control lines because they are connected in parallel. Since the system controller must be able to communicate with individual instruments on the bus, each instrument is given a unique address. The address is a 7-bit ASCII character (byte) which a given instrument recognizes and responds to.

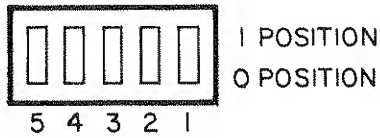
3-76. When addressing instruments, the system controller pulls the ATN line low to get the attention of all instruments on the bus. It then gives the ASCII coded address for one of the instruments on the bus. When the addressed instrument acknowledges receipt of the address by the "handshake" sequence, the controller clears the address code and addresses another instrument if more than one is to receive the same data. When the last addressed instrument acknowledges receipt of its address, the controller releases the ATN line and clears the last address code. With the ATN line released, the HP-IB is in the data mode. The addressed instruments respond by accepting data placed on the bus using the "handshake" sequence. This data programs the functions of the instruments.

3-77. The 3335A functions only as a listener on the HP-IB. It accepts instructions from the controller and responds by establishing the output parameters programmed. The 3335A can be addressed (or unaddressed) in either the LOCAL or REMOTE control mode. Note that the 3335A will not go to Remote unless it is addressed to listen *and* the REN line is low.

3-78. Changing the Listen Address. The 3335A is shipped from the factory with a listen address of ASCII character $ (octal code 044). This address can be changed by changing the positions of the rear panel listen address switches 1 through 5 which control address lines A1 through A5. Table 3-4 lists the listen addresses obtainable and the switch positions required to set each address. The addresses are provided in ASCII, Octal, Decimal and Hexadecimal codes. The upper position of the switch corresponds to "1", the lower position to "0". These positions correspond to the one's and zero's of Table 3-4. When changing the listen address, verify that the new address does not conflict with that of another instrument on the bus.

Table 3-4. Listen Addresses.

HP-IB Instrument Listen Address Switches					Instrument Listen Address			
5	4	3	2	1	ASCII	Octal	Decimal	Hex
0	0	0	0	0	SP	040	32	20
0	0	0	0	1	!	041	33	21
0	0	0	1	0	"	042	34	22
0	0	0	1	1	#	043	35	23
0	0	1	0	0	$	044	36	24
0	0	1	0	1	%	045	37	25
0	0	1	1	0	%	046	38	26
0	0	1	1	1	'	047	39	27
0	1	0	0	0	(	050	40	28
0	1	0	0	1	)	051	41	29
0	1	0	1	0	*	052	42	2A
0	1	0	1	1	+	053	43	2B
0	1	1	0	0	'	054	44	2C
0	1	1	0	1	—	055	45	2D
0	1	1	1	0	.	056	46	2E
0	1	1	1	1	/	057	47	2F
1	0	0	0	0	Ø	060	48	30
1	0	0	0	1	1	061	49	31
1	0	0	1	0	2	062	50	32
1	0	0	1	1	3	063	51	33
1	0	1	0	0	4	064	52	34
1	0	1	0	1	5	065	53	35
1	0	1	1	0	6	066	54	36
1	0	1	1	1	7	067	55	37
1	1	0	0	0	8	070	56	38
1	1	0	0	1	9	071	57	39
1	1	0	1	0	:	072	58	3A
1	1	0	1	1	;	073	59	3B
1	1	1	0	0	<	074	60	3C
1	1	1	0	1	=	075	61	3D
1	1	1	1	0	>	076	62	3E



3-79. Unaddressing. Once the 3335A is addressed to listen, it will remain addressed until it is "unaddressed" or cleared by the system controller. There are several ways to clear an address:

a. By giving the "Unlisten" comand (UNL, 077 Octal, ASCII "?") this command must be given in the HP-IB command mode (ATN line low).

b. By pulling the IFC (Interface Clear) line low. This asynchronously clears all instruments on the bus.

c. By giving the "GO TO LOCAL" command (GTL, 001 Octal, ASCII "SOH").

d. By turning the instrument off.

3-80. HP-IB Bus Commands. The Bus Commands are divided into three categories:

a. Unaddress Commands (UNL and UNT)
b. Universal Commands (LLO, DCL, SPE, etc.)
c. Addressed Commands (SDC, GTL, GET, etc.)

The 3335A will not respond to all of the bus commands. Its operation is unaffected by a command it does not recognize. The commands it will respond to are UNL (Unlisten), LLO (Local Lockout), DCL (Device Clear), SDC (Selective Device Clear) and GTL (Go To Local). Each of these commands is listed above following its respective command category.

3-81. PROGRAMMING.

3-82. Programming of the 3335A functions is by means of data messages sent by the system controller over the HP-IB.

Table 3-5. Programming Codes.

KEY	ASCII Character	Octal Code	Decimal Code	Hexadecimal Code
STORE	S	123	83	53
RECALL	R	122	82	52
FREQUENCY	F	106	70	46
FREQ INCR	I	111	73	49
AMPLITUDE	A	101	65	41
AMPTD INCR	I	111	73	49
Ø INCR	P	120	80	50
SWEEP WIDTH	W	127	87	57
DISPLAY LAST ENTRY	L	114	76	4C
0	0	060	48	30
1	1	061	49	31
2	2	062	50	32
3	3	063	51	33
4	4	064	52	34
5	5	065	53	35
6	6	066	54	36
7	7	067	55	37
8	8	070	56	38
9	9	071	57	39
		056	46	2E
BACK SPACE	B	102	66	42
CLEAR	C	103	67	43
MHz/–dBm	M	115	77	4D
kHz/+dBm	K	113	75	4B
Hz/deg	H	110	72	48
INCR ↑	U	125	85	55
INCR ↓	D	104	68	44
GOTO START FREQ	G	107	71	47
START 10 SEC SINGLE	X	130	88	58
START 50 SEC SINGLE	Y	131	89	59
START AUTO	Z	132	90	5A
STOP	Q	121	81	51
	–	055	45	2D
**See Paragraph 3-81	T	124	84	54

These messages are composed of two parts – the address command and the program information. The address command contains the "talk" and "listen" addresses of the devices involved, here the controller talk address and the 3335A listen address. The program information contains the codes of the 3335A keys to be programmed. Syntax of the address command portion of the data message is dependent on the controller used (see manual of the system controller). Syntax for the program information portion is comprised of the program codes listed in Table 3-5.

3-83. Each programming code is a single 7-bit word or "byte". Table 3-5 lists each front panel key that is programmable and lists the programming code by ASCII character and corresponding octal, decimal and hexidecimal equivalant. The last two entries of the table (– and T) are codes programmable but do not represent front panel keys. The "–" allows for ease in programming amplitudes since negative amplitudes can be preceded by the minus sign and all amplitudes finalized with the + dBm key (K) from the HP–IB. The character T is discussed in the following paragraph.

3-84. A special operating condition is obtainable by using the programming code ASCII character "T". This HP-IB command sets the attenuator to the straight-through position and the impedance to the 50 ohm mode. A change of amplitude cannot be programmed but the digits 1 through 7 will introduce the attenuator pad corresponding to the "AT" line associated with the programmed digit (i.e., programming the digit 4 causes the AT4 line to go low and introduce the 10 dB pad associated with line AT4). Programming a 0 sets the attenuator straight through again once a pad has been introduced. The digit 8 programs the 50 ohm output while the digit 9 programs the 75 ohm output. To return to normal amplitude control, the code C (CLEAR) must be programmed to exit the special operating condition. A summary of the "T" special operating codes and their function is shown in Table 3-6.

3-85. The 3335A will respond to programming codes only when it is addressed to listen in the remote mode. Front panel key instructions can be entered in any order desired by the programmer. The function key instruction must preface a data entry for that function. An entry instruction must follow the data to complete programming of the function changing that particular operating parameter. The key instruction sequence of a program is identical to the key activation sequence when operated manually. Examples of program data messages using a 9830A and 9825A calculator

3-86. Examples illustrating complete programs using a 9830A and 9825A calculator to program various parameters and functions of the 3335A are shown in Figure 3-4.

3-87. Programming the Increment Functions. Special attention to the programming of the amplitude, frequency and phase increment functions is required because the same instruction (ASCII character I) for increment is used. The increment parameter programmed depends on the instrument's operating function prior to the "I" instruction. If

the 3335A is in the frequency mode prior to the "I" instruction, FREQ INCR is programmed; if in the amplitude function prior to the "I" instruction AMPTD INCR is programmed; if in the phase mode, ϕ INCR is programmed. If the instrument is not in the frequency, amplitude or phase mode, an "I" instruction is ignored. To ensure the increment is properly programmed in either frequency or amplitude, it is recommended the increment instruction (I) be preceded by the amplitude or frequency function instruction (A or F).

NOTE

ϕ INCR can be programmed directly by the ASCII character P.

The instruction "PI" is legal but can be performed by just "P" to program ϕ INCR (see Table 3-5). The two left-most 9830A and 9825A examples in Figure 3-3 illustrate frequency programmed immediately preceding the increment instruction "I" and an "FI" instruction is not required.

Table 3-6. Special Attenuator Program Codes.

Code	AT7 40 dB	AT6 20 dB	AT5 20 dB	AT4 10 dB	AT3 4 dB	AT2 2 dB	AT1 2 dB	AT∅ 50 Ω/75 Ω
T	1	1	1	1	1	1	1	1
∅	1	1	1	1	1	1	1	**
1	1	1	1	1	1	1	∅	**
2	1	1	1	1	1	∅	1	**
3	1	1	1	1	∅	1	1	**
4	1	1	1	∅	1	1	1	**
5	1	1	∅	1	1	1	1	**
6	1	∅	1	1	1	1	1	**
7	∅	1	1	1	1	1	1	**
8	**	**	**	**	**	**	**	1
9	**	**	**	**	**	**	**	∅
C	RETURNS TO NORMAL AMPLITUDE OPERATION							

1 = Straight Through
∅ = Pad Introduced
** = Same As Previous State

Table 3-7. Attenuation Actuated, 50 Ohm Output Level.

Output Level (dBm)	Attenuation (dB)	Pads Actuated (dB)	Output Level (dBm)	Attenuation (dB)	Pads Actuated (dB)
+ 13.01	0	0	–36.99	50	20,20,10
+ 11.01	2	2	–38.99	52	20,20,10,2
+ 9.01	4	2,2	–40.99	54	20,20,10,2,2
+ 7.01	6	4,2	–42.99	56	20,20,10,4,2
+ 5.01	8	4,2,2	–44.99	58	20,20,10,4,2,2
+ 3.01	10	10	–46.99	60	40,20
+ 1.01	12	10,2	–48.99	62	40,20,2
– .99	14	10,2,2	–50.99	64	40,20,2,2
– 2.99	16	10,4,2	–52.99	66	40,20,4,2
– 4.99	18	10,4,2,2	–54.99	68	40,20,4,2,2
– 6.99	20	20	–56.99	70	40,20,10
– 8.99	22	20,2	–58.99	72	40,20,10,2
–10.99	24	20,2,2	–60.99	74	40,20,10,2,2
–12.99	26	20,4,2	–62.99	76	40,20,10,4,2
–14.99	28	40,4,2,2	–64.99	78	40,20,10,4,2,2
–16.99	30	20,10	–66.99	80	40,20,20
–18.99	32	20,10,2	–68.99	82	40,20,20,2
–20.99	34	20,10,2,2	–70.99	84	40,20,20,2,2
–22.99	36	20,10,4,2	–72.99	86	40,20,20,4,2
–24.99	38	20,10,4,2,2	–74.99	88	40,20,20,4,2,2
–26.99	40	20,20	–76.99	90	40,20,20,10
–28.99	42	20,20,2	–78.99	92	40,20,20,10,2
–30.99	44	20,20,2,2	–80.99	94	40,20,20,10,2,2
–32.99	46	20,20,4,2	–82.99	96	40,20,20,10,4,2
–34.99	48	20,20,4,2,2	–84.99	98	40,20,20,10,4,2,2

3-88. Programming Amplitude to Maximize Attenuator Life. The attenuator assembly of the 3335A introduces an attenuator pad by use of an electro-mechanical mechanism. As with any mechanical system, the more it is used, the greater the wear on the system. A programmer can minimize the mechanical wear on the 3335A attenuator by carefully selecting amplitudes which require minimum operation of the attenuator. Table 3-7 indicates the 50 ohm output level, the attenuation introduced by the attenuator and which pads are actuated to accomplish it. Note that the attenuator attenuates in 2 dB steps while amplitude changes from +.01 dB to +1.99 dB are realized electronically by the leveling loop circuit (A6 Assembly – Section VIII Service Group M). Programming amplitudes within the 1.99 dB capability of the leveling loop and/or selecting amplitudes that minimize pad actuations will increase attenuator life. Table 8-N-1 in Section VIII Service Group N provides a detailed indication of the attenuator pads selected for a particular programmed amplitude for both 50 ohm and 75 ohm output impedances.

3-89. Unaddressed or Local Operation When Connected To the HP-IB.

3-90. If the 3335A is connected to the HP-IB and operated locally or operated in remote but not addressed to listen, interruption of the display/keyboard scan and the sweep mode function can occur. The instrument is controlled by one microprocessor. The processor must service the instrument function and also handle the HP-IB lines. When the ATN line is true or when the 3335A is addressed to listen, microprocessor responds to every DAV handshake. As each data byte is placed on the bus, DAV is pulled true which activates the 3335A HP-IB interrupt request line (IRQ) to the controller section. This causes the controller to interrupt the scan and sweep operation and service the interrupt request before returning to local operation of the 3335A functions. If a long data string is sent on the HP-IB, a data byte rate can be achieved when the 3335A controller has only time to service the interrupt requests. At this point the 3335A controller cannot properly service the basic instrument. The following symptoms can occur; display completely or partially blanks, a keyboard entry is not recognized, sweep output is not linear, and the auto, single 10 or 50 second sweep in the sweep mode exceeds the time interval.

3-91. Telecommunications.

3-92. There is an amplitude blanking feature and a special sweep feature which make the -hp- 3335A especially suitable for applications in the telecommunications industry. These features are standard and appear on all instruments. On instruments equipped with Options 002, 003 or 004, the special sweep is switch selectable. Each feature is described separately in the paragraphs that follow.

NOTE

No instrument with a serial number below 1604A00376 is equipped with a TELECOMMUNICATIONS SWEEP Switch.

3-93. Amplitude Blanking. This feature causes the output amplitude to be blanked for 20 msec whenever a new frequency is entered or whenever the INCREMENT or DECREMENT controls are actuated. Since the amplitude is blanked, no signal will appear at the output during the time that the frequency is changing. This allows the instrument to be stepped from one channel to another without generating spurious signals that might interfere with operating channels. Amplitude Blanking is implemented by modifing the instrument internally. Only *qualified service personnel* can do the modification safely. *Hazardous voltages are exposed when the top cover is removed.* The procedure for implementing this feature is presented on the apron page of Figure 8-D-1 in Service Group D.

WARNING

Since access to the Amplitude Blanking Switch requires removal of the top cover, this feature should be implemented only by qualified service personnel. Hazardous voltage are exposed when the top cover is removed.

3-94. Telecommunications Sweep. This sweep is really a modification of the AUTO sweep. The amplitude is blanked for 20 msec after each step and the duration of each step is extended so that the time duration of the step plus the 20 msecs blanking equals 4 seconds. Since the AUTO sweep consists of 100 steps, the total sweep time is extended to 400 seconds or 6.7 minutes. Blanking the amplitude prevents the -hp- 3335A from outputting spurious signals while it is changing frequencies. The long time duration allows certain Selective Level Measuring Instruments to track the -hp- 3335A output frequency in an open loop test configuration (e.g. – see see Operating Manual for the -hp- 3745A/B Selective Level Measuring Set). If the output is displayed on an oscilloscope, a slight overshoot will be observed at the beginning of each frequency step. This is normal and will cause no problems in the tracking application for which this operating mode was designed. On instruments equipped with Options 002, 003 and 004, the communications sweep is implemented by moving the TRACK/ NORM switch, located on the rear panel, to the TRACK position. On standard instruments, it is implemented by modifying the instrument internally. Only *qualified service personnel* can do the modification safely. *Hazardous voltages are exposed when the top cover is removed.* The procedure for implementing this feature is presented on the apron page of Figure Group D.

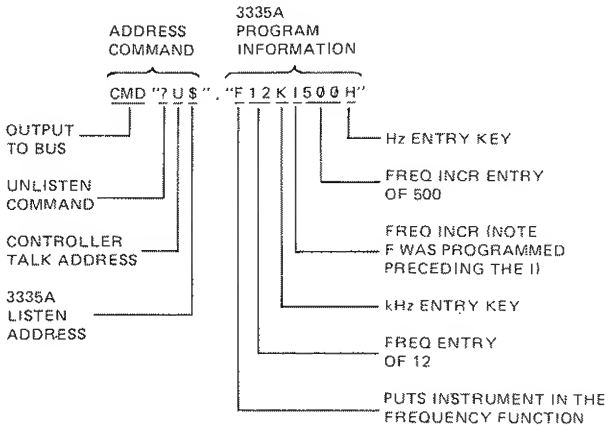
WARNING

Only qualified service personnel should implement the special sweep. Hazardous voltages are exposed when the top cover is removed.

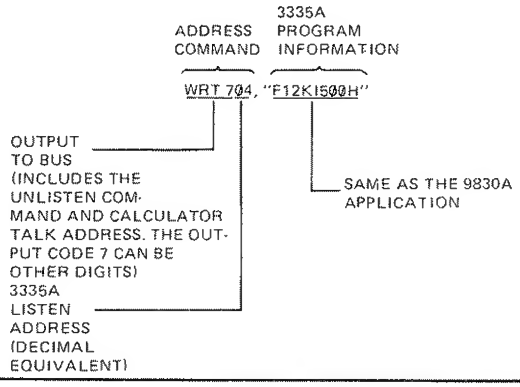
NOTE

The single sweep operating modes should not be used while the telecommunications sweep is implemented. While the frequencies of the single sweeps are correct, the amplitude is higher than the level displayed and somewhat unpredictable.

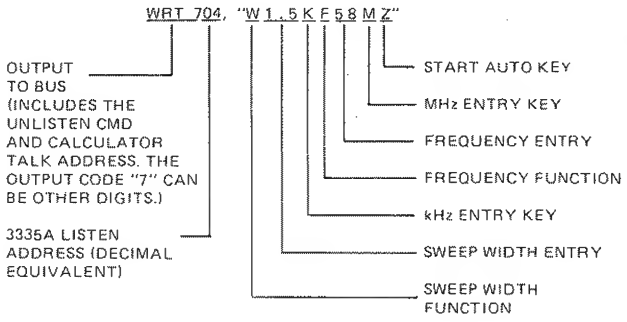
9830A Calculator program data message to establish an output frequency of 12 kHz and frequency increment of 500 Hz.



9825A Calculator program data message to establish an output frequency of 12 kHz and frequency increment of 500 Hz.



9825A Calculator program data message to establish an auto sweep with SWEEP WIDTH of 1.5 kHz centered on 58 MHz.



9825A Calculator program data message to end sweep mode operation and reprogram frequency to 25 kHz, amplitude to +9 dBm.

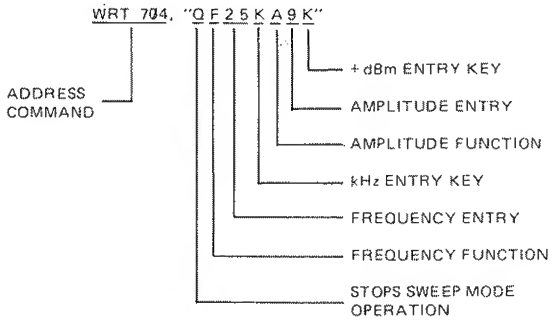


Figure 3-3. 9830A/9825A Program Data Messages.

EXAMPLE 1.

Programming a fixed frequency, e.g., 12.34 MHz:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 CMD "?U$","F12.34M"
40 OUTPUT (13,10)1024;
50 END
```

9825A PROGRAM

```
0: rem 7
1: wrt 704,"F12.34M"
2: lcl 7
3: end
*26953
```

EXAMPLE 2.

Programming a fixed amplitude, e.g., –40.01 dBm:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 CMD "?U$","A40.01M"
40 OUTPUT (13,10)1024;
50 END
```

9825A PROGRAM

```
0: rem 7
1: wrt 704,"A40.01M"
2: lcl 7
3: end
*28257
```

EXAMPLE 3.

Programming a fixed frequency increment, e.g., 4 kHz:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 CMD "?U$","FI4K"
40 OUTPUT (13,10)1024;
50 END
```

9825A PROGRAM

```
0: rem 7
1: wrt 704,"FI4K"
2: lcl 7
3: end
*29653
```

EXAMPLE 4.

Programming a frequency to be entered from the calculator keyboard:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 DISP "DESIRED FREQUENCY (IN MHZ)";
40 INPUT F
50 CMD "?U$"
60 FORMAT "F",F13.9,"M"
70 OUTPUT (13,60)F
80 OUTPUT (13,10)1024;
90 END
```

9825A PROGRAM

```
0: rem 7
1: ent "Desired Frequency (in MHz)?",F
2: fmt "F",f13.9,"M"
3: wrt 704,F
4: lcl 7
5: end
*16851
```

Figure 3-4. 9830A/9825A Program Examples.

EXAMPLE 5.

Programming an amplitude to be entered from the calculator keyboard:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 DISP "DESIRED AMPLITUDE (IN DBM)";
40 INPUT A
50 CMD "?U$"
60 FORMAT "A",F6.2,"K"
70 OUTPUT (13,60)A
80 OUTPUT (13,10)1024;
90 END
```

9825A PROGRAM

```
0: rem 7
1: ent "Desired Amplitude (in dBm)?",A
2: fmt 1,"A",f6.2,"K"
3: wrt 704.1,A
4: lcl 7
5: end
*12910
```

NOTE

The + dBm programming code is used for both a negative and positive amplitude entry since the 3335A will recognize a negative sign entered by the calculator.

EXAMPLE 6.

Programming a frequency sweep—all parameters entered from the calculator keyboard:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 DISP "START FREQ (IN MHZ)";
40 INPUT A
50 DISP "STOP FREQ (IN MHZ)";
60 INPUT B
70 DISP "# OF STEPS";
80 INPUT C
90 DISP "TIME PER STEP (IN MSEC)";
100 INPUT D
110 X=(B-A)/C
120 CMD "?U$"
130 FORMAT "F",F13.9,"M"
140 FOR F=A TO B STEP X
150 OUTPUT (13,130)F
160 WAIT D
170 NEXT F
180 OUTPUT (13,10)1024;
190 END
```

9825A PROGRAM

```
0: rem 7
1: ent "Start Freq (in MHz) ?",A
2: ent "Stop Freq (in MHz) ?",B
3: ent "# of Steps ?",C
4: ent "Time per Step (in msec) ?",D
5: (B-A)/C→X
6: fmt "F",f13.9,"M"
7: for F=A to B by X
8: wrt 704,F
9: wait D
10: next F
11: lcl 7
12: end
*2524
```

NOTE

If you prefer to enter center frequency and sweep width rather than start and stop frequencies, make the following changes to the respective lines of the Example 6 programs:

9830A PROGRAM CHANGES

```
30 DISP "CENTER FREQ (IN MHZ)";
50 DISP "SWEEP WIDTH (IN MHZ)";
110 X=B/C
```

9825A PROGRAM CHANGES

```
1: ent "Center Frequency (in MHz) ?",A
2: ent "Sweep Width (in MHz) ?",B
5: B/C→X
```

Figure 3-4. 9830A/9825A Program Examples (Cont'd).

EXAMPLE 7.

Programming a log sweep—all parameters entered from the calculator keyboard:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 DISP "START FREQ (IN MHZ)";
40 INPUT A
50 DISP "STOP FREQ (IN MHZ)";
60 INPUT B
70 DISP "# OF STEPS";
80 INPUT C
90 DISP "TIME PER STEP (IN MSEC)";
100 INPUT D
110 CMD "?U$"
120 FORMAT "F",F13.9,"M"
130 FOR I=0 TO C
140 F=10↑(LGTA+(LGTB-LGTA)*(I/C))
150 OUTPUT (13,120)F
160 WAIT D
170 NEXT I
180 OUTPUT (13,10)1024;
190 END
```

9825A PROGRAM

```
0: rem 7
1: ent "Start Freq (in MHz) ?",A
2: ent "Stop Freq (in MHz) ?",B
3: ent "# of Steps ?",C
4: ent "Time per Step (in msec) ?",D
5: fmt 1,"F",f13.9,"M"
6: for I=0 to C
7: 10↑(log(A)+(log(B)-log(A))(I/C))→F
8: wrt 704.1,F
9: wait D
10: next I
11: lcl 7
12: end
*31968
```

EXAMPLE 8.

Programming an amplitude sweep—all parameters entered from the calculator keyboard:

9830A PROGRAM

```
10 FORMAT B
20 OUTPUT (13,10)768;
30 DISP "START AMPLITUDE (IN DBM)";
40 INPUT A
50 DISP "STOP AMPLITUDE (IN DBM)";
60 INPUT B
70 DISP "# OF STEPS";
80 INPUT C
90 DISP "TIME PER STEP (IN MSEC)";
100 INPUT D
110 X=(B-A)/C
120 CMD "?U$"
130 FORMAT "A",F6.2,"K"
140 FOR I=A TO B STEP X
150 OUTPUT (13,130)I
160 WAIT D
170 NEXT I
180 OUTPUT (13,10)1024;
190 END
```

9825A PROGRAM

```
0: rem 7
1: ent "Start Amplitude (in dBm) ?",A
2: ent "Stop Amplitude (in dBm) ?",B
3: ent "#of Steps ?",C
4: ent "Time per Step (in msec) ?",D
5: (B-A)/C→X
6: fmt 1,"A",f6.2
7: for I=A to B by X
8: wrt 704.1,I
9: wait D
10: next I
11: lcl 7
12: end
*30595
```

Figure 3-4. 9830A/9825A Program Examples (Cont'd).